Examiners' Report
Lead Examiner Feedback

June 2022

Pearson BTEC Nationals
In Applied Science (31627H)
Unit 5: Principles and Applications of Science II

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Grade Boundaries

What is a grade boundary?

A grade boundary is where we set the level of achievement required to obtain a certain grade for the externally assessed unit. We set grade boundaries for each grade, at Distinction, Merit and Pass.

Setting grade boundaries

When we set grade boundaries, we look at the performance of every learner who took the external assessment. When we can see the full picture of performance, our experts are then able to decide where best to place the grade boundaries – this means that they decide what the lowest possible mark is for a particular grade.

When our experts set the grade boundaries, they make sure that learners receive grades which reflect their ability. Awarding grade boundaries is conducted to ensure learners achieve the grade they deserve to achieve, irrespective of variation in the external assessment.

Variations in external assessments

Each external assessment we set asks different questions and may assess different parts of the unit content outlined in the specification. It would be unfair to learners if we set the same grade boundaries for each assessment, because then it would not take accessibility into account.

Grade boundaries for this, and all other papers, are on the website via this link

Awarding BTEC qualifications in 2022

Ofqual has set out their plans for awarding qualifications in 2022 and intend to return to a normal, pre-pandemic, approach to grading standards over by 2023. They have confirmed that 2022 will be a transition year, to reflect that we are in a pandemic recovery period and learners' education has been disrupted.

Our guiding principle and approach to awarding BTEC qualification results in 2022 will be to ensure parity in relation to the approach being taken for GCSE and A level learners. BTEC courses have a different structure and design to academic qualifications - BTECs are modular qualifications (with assessments taking place throughout the course) compared to GCSEs and A levels which

are linear (assessed and awarded at the same time at the end of the year), and therefore our approach needs to be different.

In 2022 we will return to the usual method of calculating BTEC qualification results, however adaptations including, U-TAGs and reduced internal assessment, are in place to provide a comprehensive package of support for learners.

The basis of our awarding approach to BTECs this year is to ensure it is as fair as possible for all learners. We will use a range of evidence to set grade boundaries for the external units. Part of this evidence will be to closely monitor learner performance in all assessments that contribute to learners' final qualification grade, to ensure parity with A level and GCSEs.

Further information can be found on our website and via our Social Media channels.

Introduction

Biology

31627H1B is the biology section of the externally assessed unit, unit 5. This unit, Organs and Systems, covers the cardiovascular system (B.1), the respiratory system (ventilation and gas exchange in the lungs) (B.2), the structure and functions of the urinary system (B.3), and cell transport mechanisms (B.4).

This was the ninth series of the new specification. It was the sixth time that learners had sat the Biology, Physics and Chemistry sections as individual papers.

The question paper followed the same format as for the previous papers and for the sample assessment material. It consisted of five questions, four of which consisted of smaller items; there were 18 items in total. These included four multiple choice items and three other single mark questions testing mainly recall of knowledge. There were some 2, 3 and 4 mark items, each carrying a greater cognitive demand, where learners had to analyse or interpret information or apply their knowledge to a new scenario. These questions were marked using a points-based mark scheme.

The last question carried 6 marks and was marked using a levels-based approach that considered the overall quality of the response and not just the amount of correct and relevant facts presented by the learner. More detail can be found below, in the individual question section of the report.

Introduction to the Overall Performance of the Unit

Many learners were well prepared, by their centres, for the examination; they read the questions carefully with due consideration of the command word used and subsequently selected appropriate and relevant information to use in their responses.

However, a significantly high number of learners did not sensibly use information in the stem of the question. This type of omission was seen particularly in Q1(c) where they were told that one function of the kidneys is excretion and were asked to state **one other** function but

many gave descriptions of excretion or a process involved in the excretory function, such as filtering the blood.
Some responses to very straightforward questions such as naming a region on a spirometer trace, were disappointing, indicating that perhaps this is an area that is not well understood. This was also the case for the question about the use of peak expiratory flow rate to assess COPD.

A significant number of learners, surprisingly, failed to correctly identify the AV valve in the diagram of the heart.
Some learners also did not select the correct data from a graph to calculate breathing rate and instead used volume values from the y axis.
Some learners need more practice at using data from graphs.

Introduction

Chemistry

This is the ninth examination series for the Unit 5 - Principles and Applications of Science II, Chemistry: Properties and uses of substances.

The following topics were covered:

- Question 1: the properties of aluminium and aluminium oxide (A1); the extraction of aluminium from aluminium oxide (A1)
- Question 2: energy transfer (A3); standard enthalpy change of combustion (A3); calculation of pressure using the equation $\Delta H = \Delta U + p\Delta V$ (A3)
- Question 3: naming and deducing structural / molecular formulae in organic chemistry (A2); electrophilic addition and the species involved (A2); the effect of symmetry of alkenes upon the products formed (A2)
- Question 4: understanding the role of iron and its ions in the catalysis of reactions (A1)

Introduction to the Overall Performance of the Unit

In general, learners performed similarly on this paper by comparison to recent series.

Areas where learners performed well were:

- stating one or more useful properties of aluminium in relation to a specific use – Q1(a)
- identifying the name of the ore that aluminium oxide is extracted from - Q1(b)(i)
- balancing a chemical equation – Q1(b)(ii)
- categorising the acid-base character of at least one metal oxide – Q1(b)(iii)
- knowing that heat energy transfer is between a system and its surroundings (from learners at Pass and above) – Q2(a)
- calculating pressure given the equation $\Delta H = \Delta U + p\Delta V$ – Q2(c)
- identifying the name of an organic compound – Q3(a)(i)
- making connections between characteristics of catalysis and a specific example – Q4

Areas where learners did **not** perform as well were:

- explaining an aspect of electrolysis / extraction of aluminium – Q1(c)
- recognising the standard enthalpy change of combustion, conventions and relative amounts of heat energy lost – Q2(b)
- drawing or deducing structural and molecular formulae from an organic reaction scheme – Q3(a)(ii) and (ii)
- defining or explaining the term “electrophile” – Q3(b)(i)
- identifying and explaining errors in an electrophilic addition mechanism – Q3(b)(ii)
- identifying the most stable carbocation from a selection – Q3(b)(iii)
- explaining the effect of symmetry of different alkenes upon the addition products formed with HBr – Q3(c)
- basic knowledge of catalysis (from borderline Pass learners) and comprehensive application of knowledge to more than one example (from borderline Distinction learners) - Q4

Introduction

Physics

31627H1P is the Physics section of the externally assessed component, unit 5. The Physics section of the unit, Principles and Applications of Science I. The physics section covers Thermal Physics, Materials and Fluids.

The question paper followed the same format as for the previous papers and for the sample assessment material.

Each question in the following report gives further details of what was tested in the question and the question types.

Introduction to the Overall Performance of the Unit

Compared to the January 2022 series, learners found the June 2022 paper a little more difficult, however learners were still able to show a range of skills and some knowledge across a wide variety of specification points.

Learners' mathematical skills remain good in answers to calculation questions. Learners were generally able to access the calculations on the paper, the questions where mathematical skills were tested were, Q1(c)(ii), Q3(c), Q4(b)(i), and Q5(c). There remain some aspects of mathematical skills that are problematic, for example rearranging equations, converting between centimeters and metres or grams and kilograms, or using standard form in calculations correctly.

Some learners scored less well in some calculations because of significant power of ten errors that came about from not checking their working and learners not really being aware of scale of size, this was particularly the case in Q3(c).

The use of some command words remains a challenge to learners. In particular the command 'explain', requires an identification and some form of expansion to score full marks. Learners were better able to provide complete answers to commands such as 'state', 'calculate 'and 'draw'.

Learners continue to find recalling information from the specification more of a challenge in this paper. Q1(b) showed this. The question asked for a definition of the second law of thermodynamics by means of a sentence completion task. The word being looked for was 'entropy', and very few learners scored this mark. In Q3(a) the recall of what a heat engine was not well understood and in Q4(a)(ii) the concept of the how a puddle evaporates was not well understood.

The examination covered a range of topics from the specification and included some areas that were identified in the additional guidance document for Unit 5. The areas where learners showed good knowledge and understanding were section C2 'Materials in domestic and industrial applications and parts of C1 'Thermal physics in domestic and industrial applications.' Areas where learners struggled to provide answers were for C1 in the section relating to thermodynamics and applying the kinetic theory to various situations and in section C3, the section relating to fluid flow and pressure related to Bernoulli's principle.

As in previous series several misconceptions relating to physical laws and principles remains. For instance, in Q2(b), many learners were confused as to how to draw lines to show streamline flow and were not sure as to what was needed to answer the question. In Q2(c) in applying Bernoulli's principle to a truck and a car. In Q4(a)(ii) in describing the process of evaporation and explaining why temperature is unaffected in a change of state in Q4(b)(ii).
Some learners remain unfamiliar with the meanings of symbols used in the equations that learners are expected to apply in this unit. For example, in the relationship $W = ½ k(\Delta x)^2$ used in Q5(c). This was also the case in the previous series where the symbol Δ was used in a different equation.

Individual Questions

Biology

Question 1

Question 1 focused on the structure and functions of kidneys.
Some questions involved recall and some required interpretation and application of knowledge. One item tested a maths skill.

Q1(a)

For this question learners were given a diagram of a nephron and were asked to identify the region where selective reabsorption happens. Many learners correctly chose the option proximal convoluted tubule. A few chose distal convoluted tubule and a small number did not know and appeared to guess, choosing collecting duct of Bowman's capsule.

Q1(b)

In this question learners were asked to identify region X on the diagram of the nephron. Most learners correctly named it as the loop of Henle.

Q1(c)

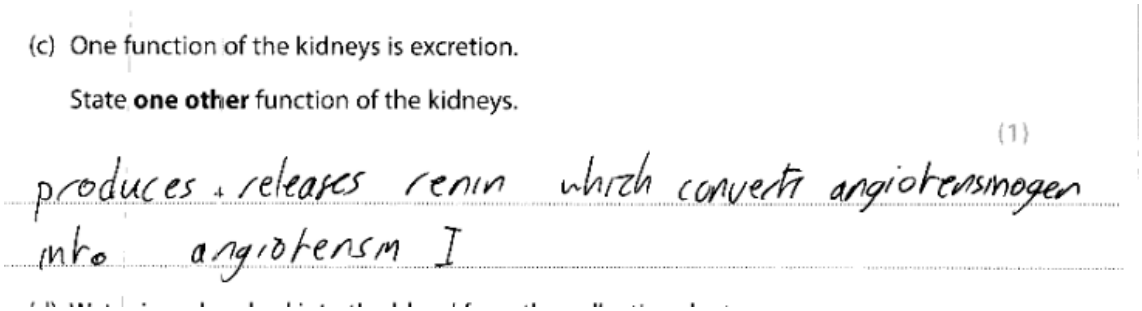
In this question learners were told that one function of the kidneys is excretion and were asked to state **one other** function. A surprisingly large number gave excretion as their response or a description of excretion or an aspect of it such as 'filtering/removing toxins/purifying blood'.

The expected response was osmoregulation as the specification lists excretion and osmoregulation as two functions of the kidneys. However, there were a number of other acceptable responses such as

- regulation of blood pressure
- maintaining acid-base balance of body fluids/regulating blood pH
- electrolyte balance
- salt-water balance (a description of osmoregulation)
- making EPO
- making oestrogen

For the learners who gave a correct response, most of the above were covered. However, some confused the kidneys with adrenal glands and incorrectly stated that the kidneys make adrenaline, or they gave a vague reference to the kidneys making hormones, which did not score a mark.

Lead Examiner comment: *The response below gained the mark for describing a stage in the regulation of blood pressure by the kidneys, thus demonstrating some very good knowledge.*


(c) One function of the kidneys is excretion.

State **one other** function of the kidneys.

(1)

produces + releases renin which converts angiotensinogen into angiotensin I

Q1(d)

In this question learners were told that water is absorbed from the collecting duct into the blood, causing the urine to become more concentrated. They were then asked to describe how water is absorbed from the collecting duct. Many learners answered this very well with good detail about the effect of ADH on the permeability of the CD walls and the role of aquaporins in the movement of water down a water potential (water concentration) gradient by osmosis.

This response scored 3 marks

(d) Water is reabsorbed into the blood from the collecting duct.

This causes the urine to become more concentrated.

Describe **how** water is reabsorbed from the collecting duct.

(3)

ADH increases the permeability of collecting duct, sodium ions reabsorbed to the blood. This leads to ~~high~~ a lower water potential in blood than the ~~high~~ collecting duct. However water is then reabsorbed by osmosis ↓down water potential gradient.

Lead Examiner comment: *The learner has correctly stated that ADH increases the permeability of the collecting duct, which gains 2 marks, and then says water is absorbed by osmosis down the water potential gradient. This covers another two marking points but the maximum for this question is three marks.*

This response gained 1 mark for referring to aquaporins

water is reabsorbed in the collecting duct through aquaporins, they allow for water to pass through the wall of the collecting duct by attaching to the cells

Q1(e)(i)

In this question learners were asked to select relevant data from a table and use it in a calculation.

(e) Table 1 shows the concentration of some of the substances in fluids taken from three locations in the body:

- blood in the renal artery
- kidney filtrate in the proximal convoluted tubule (PCT)
- urine in the bladder.

substance	blood in renal artery (g per L)	kidney filtrate in PCT (g per L)	urine in bladder (g per L)
glucose	1.00	1.00	0.00
urea	0.33	0.33	20.00
sodium ions	3.00	3.00	6.00
protein	70.00	0.00	0.00

Table 1

(i) Sodium ions in urine are two times more concentrated than sodium ions in the blood.

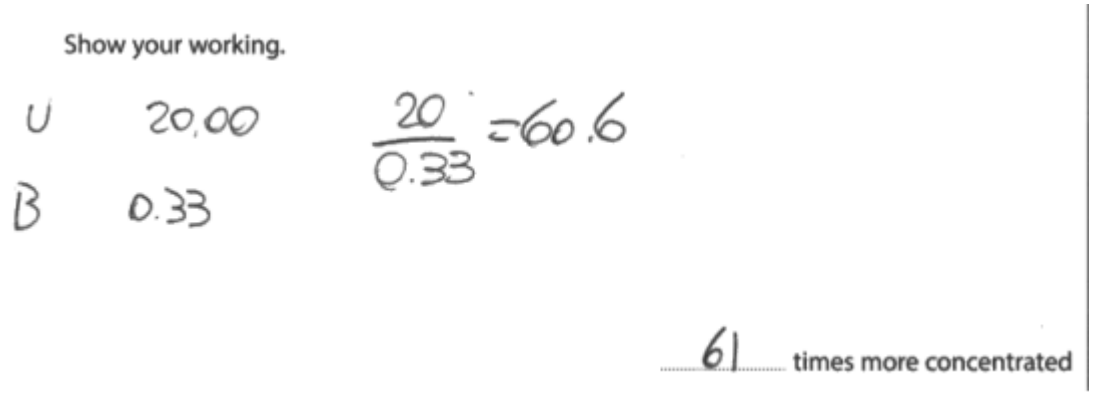
Calculate how many times more concentrated urea is in the urine than urea is in the blood.

(2)

Many learners chose the correct values of 20 and 0.33 and divided 20 by 0.33 arriving at the correct answer of 60.6 or correctly rounding to 61. Such responses gained 2 marks.

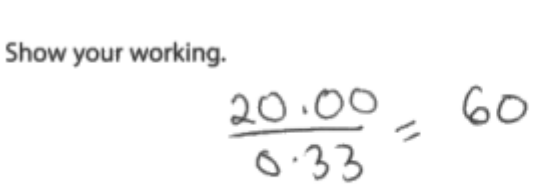
Some learners got the sum upside down and so lost a mark. Some selected inappropriate data from the wrong columns, often data about sodium ion concentrations which was not relevant and not answering the question.

This response gained 2 marks



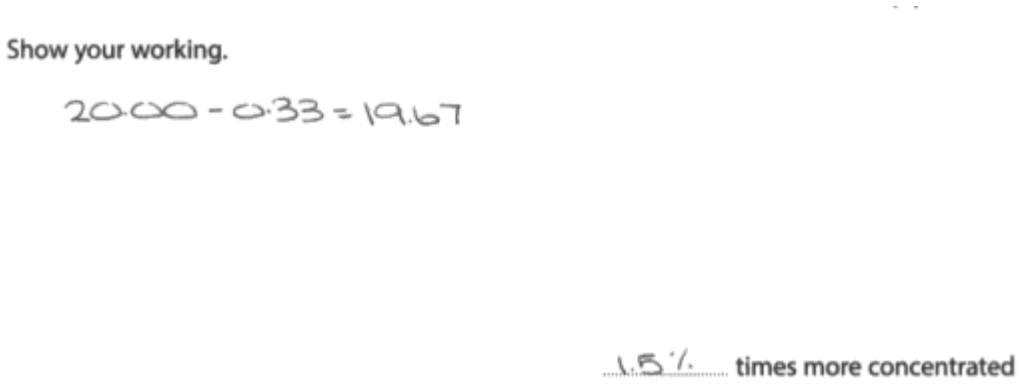
Lead Examiner comment: *The learner has selected the correct data and carried out a correct calculation and rounded correctly. Had they not rounded and left it at 60.6 they would also have got 2 marks.*

This response gained 1 mark



Lead Examiner comment: *The learner carried out a correct calculation but then incorrectly rounded to 60.*

This response gained 0 marks


Show your working.

20·00 - 0·33 = 19.67

1.5% times more concentrated

Lead Examiner comment: *The learner selected correct data but then subtracted rather than divided.*

Q1(e)(ii)

In this question learners were asked to give one reason why there is no protein in the urine. Many said that the molecules were too large to be filtered, some giving good detail such as 'too large to get through the basement membrane'. Some gave teleological answers such as 'it is needed by the body' but these were not credited.

Question 2

This question focussed on movement across cell membranes, in the context of phagocytosis, and also looked at the consequences of phagocyte action in the lungs, and its effect on gas exchange.

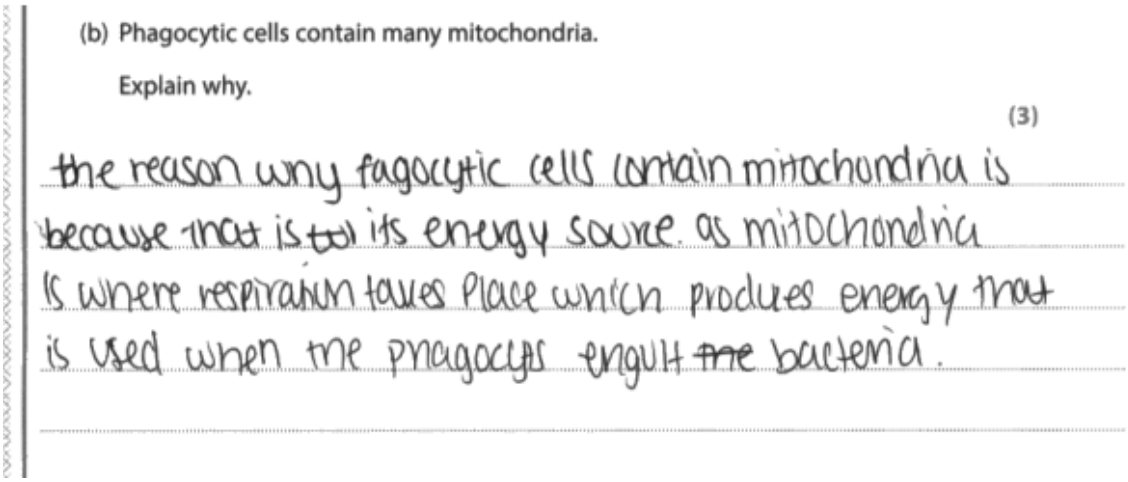
Q2(a)

This multiple-choice item asked learners which process white blood cells in the lungs used to ingest bacteria. Most correctly identified the process as endocytosis. The most common incorrect response was exocytosis.

Q2(b)

Learners were told that phagocytic cells have many mitochondria and were asked to explain why. Good responses said that these cells need energy for ingesting the bacteria, or that endocytosis is active and needs ATP, and that the ATP is made in the mitochondria during aerobic respiration.

This response gained 3 marks



(b) Phagocytic cells contain many mitochondria.

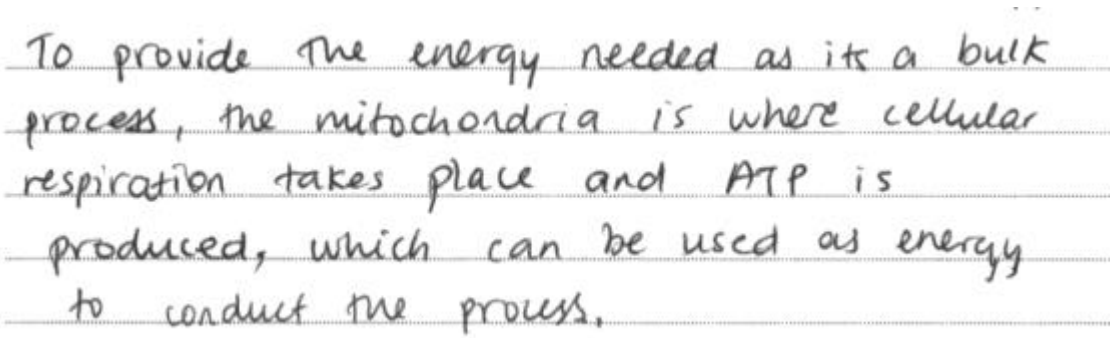
Explain why.

(3)

the reason why fagocytic cells contain mitochondria is because that is ~~to~~ its energy source. as mitochondria is where respiration takes place which produces energy that is used when the phagocytes engulf ~~the~~ bacteria.

Lead Examiner comment: *The learner clearly explains that mitochondria are the energy source and, although they do not refer to aerobic respiration, they refer to respiration in the mitochondria which is acceptable and they link the energy being released to energy being needed for the engulfing process.*

This response gained 2 marks



To provide the energy needed as its a bulk process, the mitochondria is where cellular respiration takes place and ATP is produced, which can be used as energy to conduct the process.

Lead Examiner comment: *It repeats the mark for energy/ATP and links it to respiration in the mitochondria but bulk process is a bit too vague. Had they said bulk transport needs ATP they would have got the third mark.*

Question 3

This question focussed on the heart, especially valves, its myogenic nature, its blood supply and one part of the question linked to transplants.

Q3(a)(i)

In this multiple-choice item learners were asked which symbol shows the location of the SAN. Many opted for the correct response but the most common incorrect answer was to show that it was at the top of the septum, showing that some learners confused the SAN with the AVN.

Q3(a)(ii)

In this question learners were asked to name structure Y, which was the left atrioventricular valve. They did not have to specify that it was the left AV valve but were penalised if they incorrectly identified it as the right AV valve. Bicuspid and mitral were acceptable alternatives for the name of the valve.

Quite a number of learners did specify incorrectly that it was the right valve. However, they should know that in anatomical diagrams when viewing a structure from the ventral surface, the left structure is on the right hand side of the page. Some learners mistakenly identified it as the tricuspid valve, probably because they did not appreciate that the left valve is shown on the right side of the diagram.

This learner has scored the mark for both Q3(a)(i) and Q3(a)(ii)

3 Figure 2 shows a section through a human heart.

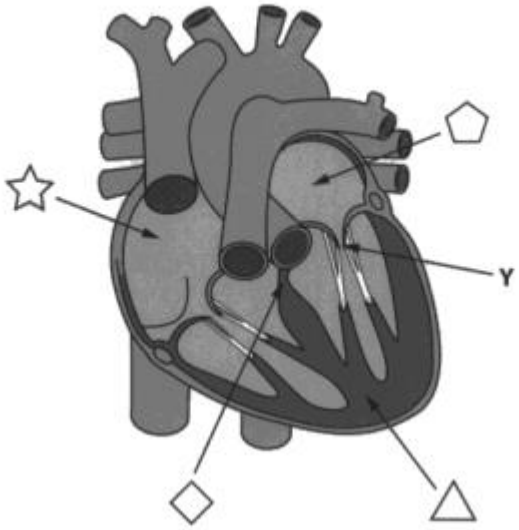


Figure 2

(a) (i) Which symbol, in Figure 2, shows the location of the sinoatrial node (SAN)?

(1)

- ☒ **A** ☆
- ☒ **B** ◇
- ☒ **C** ⬠
- ☒ **D** △

(ii) Name structure **Y** in Figure 2.

(1)

Septum / septum AV valve

Q3(b)

In this question learners were asked to complete a sentence to explain the meaning of the term 'myogenic'.

Many learners scored both marks, for saying that heart muscle contracts or beats or pumps on its own without any stimulation from nerves. The terms 'neurones' or 'brain' were allowed as alternatives to nerves but not electrical impulses as those are generated by the specialised muscle tissue in the SAN and conducted across cardiac muscle cells and down the specialised muscle fibres, in the septum, the Purkyne fibres. It is a fairly common misconception that there is nerve tissue in the heart but this is not the case.

Q3(c)(ii)

In this question learners were asked to describe the function of the coronary arteries. They had a diagram showing them where these arteries are.

Many of the answers here were disappointing. Some learners thought the coronary arteries carried deoxygenated blood and of those that correctly stated they carried oxygenated blood not many knew that the blood supplied the heart muscle. Many thought it went to the lungs or around the body. For those learners who knew it, it was encouraging to see that they specified heart muscle and not just heart, therefore indicating they knew that the heart muscle is metabolically active and needs a lot of energy/ATP for contracting, and therefore a lot of oxygen for aerobic respiration to make the ATP.

This response gained 2 marks

(c) (i) Figure 3 shows a heart, aorta and coronary arteries.

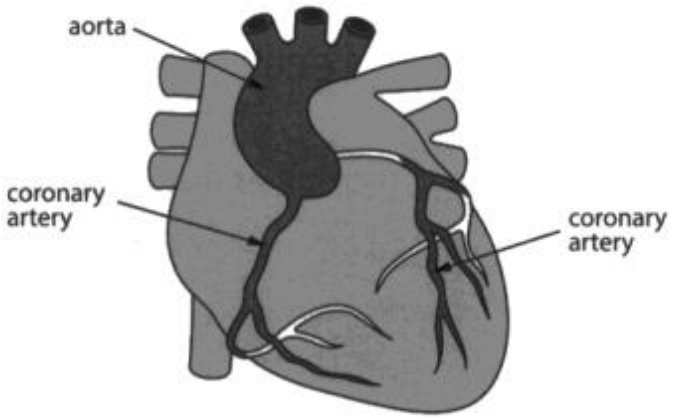


Figure 3

Describe the function of the coronary arteries.

(2)

The coronary arteries provide oxygenated blood to the muscles of the heart.

Lead Examiner comment: *The response is accurate and clearly stated.*

This response gained 1 mark

Describe the function of the coronary arteries.

(2)

• ~~Aloes~~ to take some of the oxygenated blood to the base of the heart.

• to oxygenate the nerves.

Lead Examiner comment: *The learner did not specify heart muscle. The word heart alone is not enough to obtain the mark.*

Q3(c)(ii)

In this question learners were given a diagram showing how a blocked coronary artery can be bypassed, using a vein taken from a leg. They were asked to explain two advantages of taking the piece of vein form the patient rather than from a donor.

There were some very good responses showing a good understanding of the need to tissue match and the problems of rejections and the consequent need for immunosuppressants, or that the transplant may fail leading to the need for another surgery, which has risks. Some referred to waiting lists and the need to wait/look for a suitable donor with the same tissue match and meanwhile the need for medication and monitoring was costly. Some referred to the fact that only the patient would suffer any discomfort whereas if a donor was used, two people had to undergo surgery which is more risky and more costly. Some correctly referred to the risk of infection - either from the surgery or from the transplanted tissue and some referred correctly to the increased risk of cancer from a donated transplant. Learners were able to apply their knowledge of transplants to a novel situation – a coronary bypass.

This response gained 4 marks

(ii) Figure 4 shows how bypass surgery can treat blockages in the coronary arteries.

Bypass surgery involves a transplant operation.

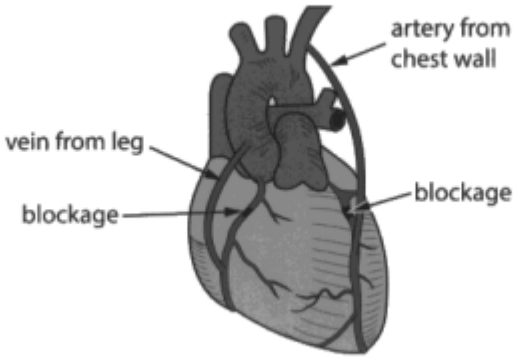


Figure 4

Explain **two** advantages of using blood vessel tissue taken from the patient, rather than tissue taken from a donor.

(4)

1 They will be a perfect genetic match, making the chances of the body rejecting the tissue much lower.

2 The demand from patients is higher than available donors, using tissue from the patient would be quicker as their ~~A~~ is no demand of needing tissue from a donor.

Lead Examiner comment: *The learner has correctly identified and explained, by developing the ideas, two advantages.*

This response gained 2 marks

Explain **two** advantages of using blood vessel tissue taken from the patient, rather than tissue taken from a donor.

(4)

1 when taking blood Tissue from the patient there is little to no chance of rejection from the body whereas with donor tissue it may get rejected

2 If you take tissues from the patient there is no wait times for a donor.

Lead Examiner comment: *There are two valid ideas here but neither is developed to gain the other marks*.

Question 4

Question 4 focused on the respiratory system with a particular emphasis on the use of spirometers.

Q4(a)

Learners were asked to identify the region on a spirometer trace that shows the total lung capacity. Many correctly identified D but C was often wrongly chosen.

Q4(b)

Learners were asked to explain the importance of volume E shown in the spirometer trace. Only about half of the learners correctly identified E as the residual volume or gave an accurate description of residual volume and about half of those correctly stated that it prevented the alveoli from sticking together or prevented the lung collapsing.

This response scored both marks

(b) Explain the importance of volume **E** shown in Figure 5.

(2)

E is the volume of air still in the lungs, even after a large exhale. This volume of air stops the walls of the lungs sticking together or collapsing.

Lead Examiner comment: *The learner has described residual air and said that it prevents the lungs from collapsing.*

This response scored 1 mark

(b) Explain the importance of volume **E** shown in Figure 5.

(2)

volume E shows the residual air. this is the air that remains in the lungs after forced exhalation or normal exhalation.

Lead Examiner comment: *The learner correctly named the volume E as residual air and then described residual volume, reiterating the same marking point.*

Q4(c)

Learners were asked to calculate the breathing rate of the person whose spirometer trace is shown.

4 Figure 5 shows a spirometer trace for a person.

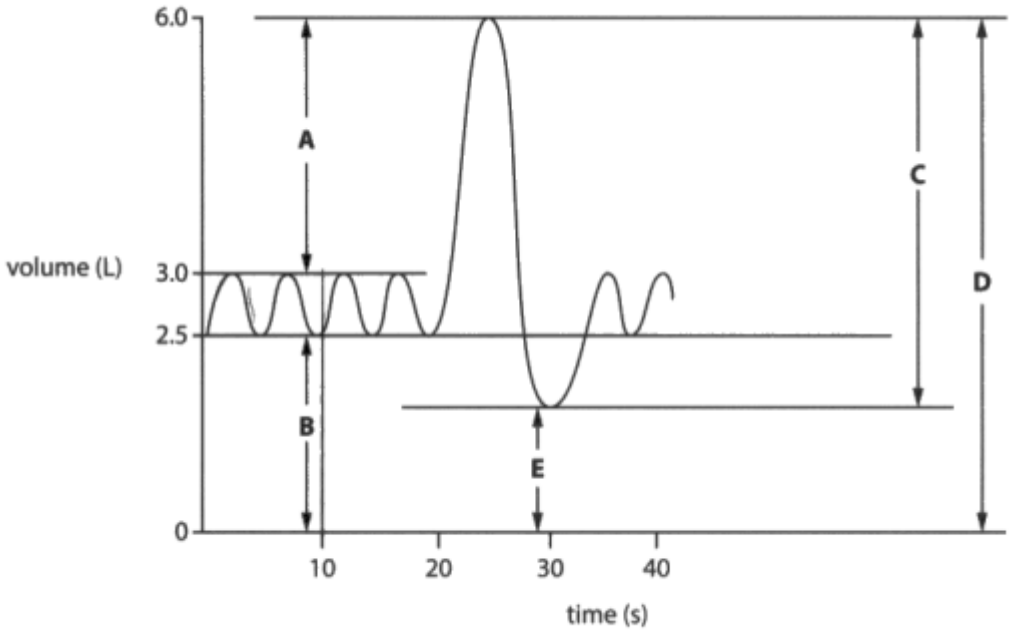


Figure 5

Learners were expected to select relevant data – for example that 4 breaths occurred in 20 seconds, or 2 breaths in 10 seconds, and then carry out a calculation to find how many breaths would occur in 60 seconds.

About half of the learners did this and reached the correct answer of 12 breaths per minute. They should also be able to common sense check that answer as they should have an idea about resting breathing rate. However, some counted the big breath in and out as part of the normal breathing. Others used the volume values from the y axis and arrived at an incorrect answer by an incorrect calculation.

This response gained 3 marks for a correct answer

(c) Calculate the breathing rate of this person, in breaths per minute. (3)

Use information in Figure 5.

Show your working.

2 breaths every 10 seconds

2 x 6 = 12 breaths per minute

breathing rate = 12 breaths per minute

This response gained 0 marks

Use information in Figure 5.

Show your working.

3.0L - 2.5L = 0.5L

0.5 X 20s = 10 breaths per 1s

60 x ↓

= 600 breaths Per min

Lead Examiner comment: *No marks for using incorrect data and arriving at an answer that the learner should realise is not likely to be correct.*

Q4(d)

This question asked learners to complete a paragraph of some information about breathing and gaseous exchange.

(d) Paragraph 1 describes some information about breathing and gaseous exchange.

The volume of air inhaled in one breath is called the ..... M .....

As this air travels through the trachea, into the ..... N ..... and then into the bronchioles, there is no gaseous exchange.

Alveoli cells make a substance called ..... O ..... to prevent alveoli from collapsing.

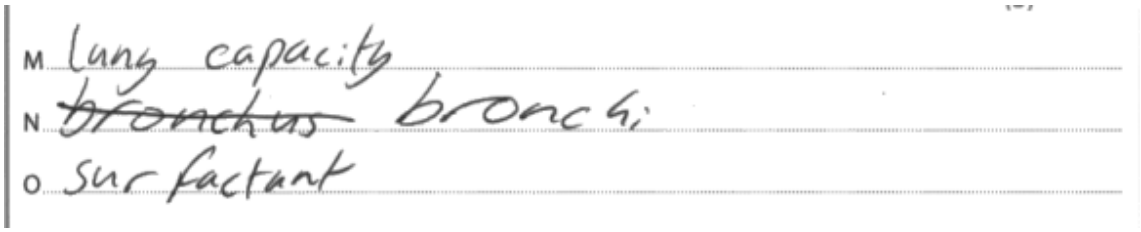
Paragraph 1

Identify the missing words M, N and O in Paragraph 1.

(3)

The majority of learners identified N as bronchi and O as surfactant but fewer correctly identified M as the tidal volume.

This response scored 2 marks



Lead Examiner comment: *The learner has incorrectly identified M as the lung capacity.*

This response gained 1 mark

Lead Examiner comment: *The learner correctly identified M but gave bronchole for N. This is too similar to bronchiole and not close enough to bronchus to be creditworthy.*

Q5

This 6 mark question is marked using a levels-based approach, not points-based as for all of the other questions on the paper.

The question asked learners to discuss how peak expiratory flow rate (PEFR) can be used to assess respiratory conditions such as chronic obstructive pulmonary disease in a person.

This appeared to be an area of the specification that was not well understood. Many learners wrote about spirometers and volumes of air and some wrote about blood flow and how that can be measured. There were few good Level 3 responses and of those the learners wrote about how a peak flow meter is used, how health professionals can use the results to diagnose COPD or asthma, emphysema or bronchitis and how the patient can use the peak flow meter at home daily and keep a diary to see if their condition is improving or getting worse. These learners often also indicated that the readings from a peak flow meter can tell a person if they need to use their inhaler. Some mentioned that the values can be compared to graphs or charts to see if they are within the normal range and that results can indicate if airways are obstructed. Some of those learners who knew about using a peak flow meter gave some incorrect detail such as blowing three times and taking an average as opposed to taking the best of the three readings. Some of these learners also showed confusion by stating that the peak flow measures volume of air breathed out as opposed to speed of expiration.

Many learners wrote about spirometers which was not answering the question.

This response is worthy of Band 3 with 5 marks

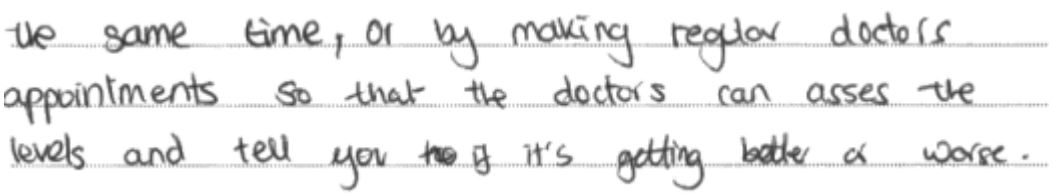
5 Discuss how peak expiratory flow rate (PEFR) can be used to assess respiratory conditions, such as chronic obstructive pulmonary disease (COPD), in a person.

Your answer should include how PEFR can be measured.

(6)

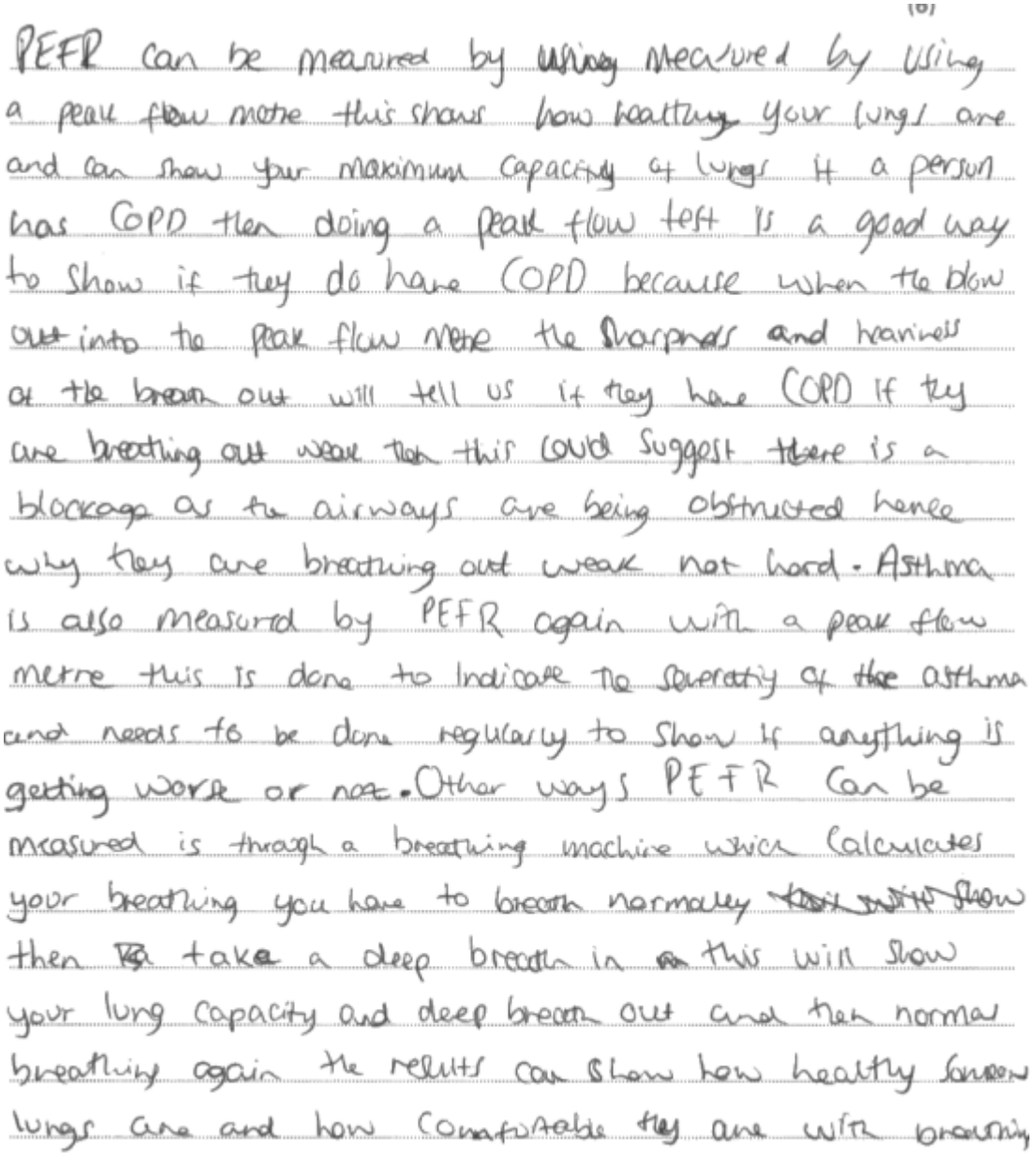
PEFR can be measured in multiple ways however one way it can be ~~meas~~ measured is by using a peakflometer. With this device it measures the maximum amount of air blown out in one breath This device will show how much air is being exhaled and should tell you ~~have~~ if there is any disease such a COPD present. However when checking this things such as age, sex and life style should be accounted for. For example ~~po~~ people who smoke will have a lower PEFR than sombody of the same age who doesn't. Aswell as this if sombody plays sport quite regularly they would be fitter then sombody who doesn't often. All of these things should be accounte for before diagnosing a problem. If the PEFR is lower than expected for ~~eith~~ after all of the lifestyle variables have been accounted for then ~~th~~ ~~this~~ diseases such as COPD and athsma can be diagnosed.

Aswell as PEFR ~~them~~ being used to ~~t~~ diagnose problems they can also be used to monotor ongoing conditions to see if they may be getting worse and other treatments should be used. The way in which this can be done is by ~~this~~ calculating your PEFR at home everyday at


the same time, or by making regular doctors
appointments so that the doctors can asses the
levels and tell you if it's getting better or worse.

Lead Examiner comment: *The response is clear and concise and well constructed. Had this learner not made the mistake of saying peak flow measured maximum amount of air, rather than maximum flow speed of exhaling, then this response would have gained 6 marks.*

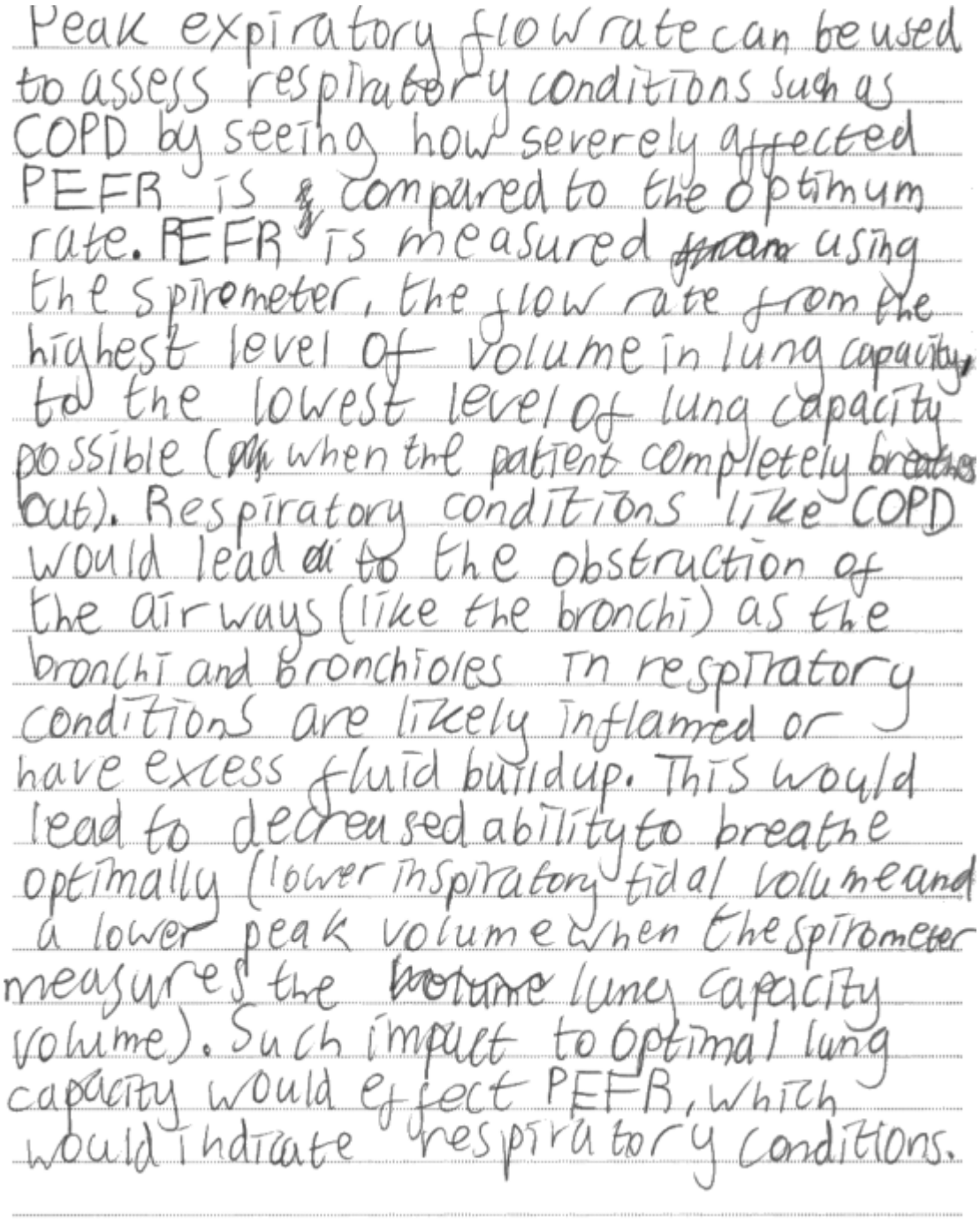
The following response was at the top of Band 2 with 4 marks



PEFR can be measured by ~~using~~ measured by using a peak flow metre this shows how healthy your lungs are and can show your maximum capacity of lungs if a person has COPD then doing a peak flow test is a good way to show if they do have COPD because when the blow ~~out~~ into the peak flow metre the sharpness and heaviness of the breath out will tell us if they have COPD if they are breathing out weak then this could suggest there is a blockage as the airways are being obstructed hence why they are breathing out weak not hard. Asthma is also measured by PEFR again with a peak flow metre this is done to indicate the severity of the asthma and needs to be done regularly to show if anything is getting worse or not. Other ways PEFR can be measured is through a breathing machine which calculates your breathing you have to breath normally ~~this with show~~ then ~~to~~ take a deep breath in ~~as~~ this will show your lung capacity and deep breath out and then normal breathing again the results can show how healthy someones lungs are and how comfortable they are with breathing

Lead Examiner comment: *This learner has made some valid points that are quite well communicated but also includes irrelevant details about using a spirometer.*

The following response was at the top of Band 1 with 2 marks


Peak expiratory flow rate can be used to assess respiratory conditions such as COPD by seeing how severely affected PEFR is compared to the optimum rate. PEFR is measured using the spirometer, the flow rate from the highest level of volume in lung capacity, to the lowest level of lung capacity possible (when the patient completely breathes out). Respiratory conditions like COPD would lead to the obstruction of the airways (like the bronchi) as the bronchi and bronchioles in respiratory conditions are likely inflamed or have excess fluid buildup. This would lead to decreased ability to breathe optimally (lower inspiratory tidal volume and a lower peak volume when the spirometer measures the lung capacity volume). Such impact to optimal lung capacity would effect PEFR, which would indicate respiratory conditions.

Lead Examiner comment: *The learner's train of thought can be followed and there are some valid points made but also quite a lot of irrelevant detail about lung volumes and spirometry.*

Summary

Based on their performance on this paper, learners should:

- Always read the question carefully and understand which command word is being used and tailor their response accordingly
- Read the information/scenario given in the stem of the question as it will help and guide them towards the appropriate response
- Sense check the answers they obtain from the mathematical calculations, for example could a breathing rate really be 600 per minute
- Examine graphical data carefully to obtain relevant data for a calculation
- Revise all topics and sub topics in the specifications
- Be aware of meanings of prefixes, for example endo- and exo- so they do not confuse endocytosis with exocytosis
- When referring to respiration indicate which type – aerobic or anaerobic
- Remember that for anatomical diagrams of structures viewed from the ventral surface the left side of the structure is on the right side of the page/diagram
- Be able to distinguish between the SAN and the AVN
- Try to spell words correctly. We usually accept phonetic spellings but sometimes a mis-spelt word becomes another word and then it cannot be accepted, for example deoxygenated and oxygenated or bronchus and bronchiole

Individual Questions

Chemistry

Q1(a)

This question was concerned with the properties of aluminium that were being utilised in a drink can. This was generally well answered, with about three-quarters of learners able to give at least one property that was relevant. This was generally with regards to the malleability, strength or low density of aluminium, but it was also common to see ideas of its lack of reactivity with the contents or its surroundings. An explanation of these properties was not required, but better learners did provide a justification. However, some learners failed to score if their response was too ambiguous (eg aluminium is unreactive), repeated themselves (eg malleable and could be easily shaped) or was not actually a property (eg can be recycled). It was common to see properties of aluminium that were not directly relevant (eg high boiling point, electrical conductor) and also did not score.

A minority of learners attempted to provide more than two properties (or a list). This strategy should be discouraged. Even though there may be some properties in the list that are relevant, there may also be others that are not. Consequently, correct and incorrect answers cancel each other leading to a reduction or no mark being awarded.

Give **two** properties of aluminium that are important when the metal is used for drink cans.

(2)

1 They have a high melting & boiling point.

2 They ~~is~~ are resistant to corrosion & have a high density.

Lead Examiner comment*:** *0 marks – the first response line would not score a mark as neither high melting or boiling point are relevant to the use as a drink can. The second response line also does not score. Although resistance to corrosion is relevant, the density of aluminium is incorrectly described as high. The response is an example of a "list" and exceeds the requirement for* ***two *properties only.*

Q1(b)(i)

This multiple-choice question tested whether learners could identify the name of the ore of aluminium oxide. About 75% of learners correctly identified bauxite. Other options were selected in equal measure, with a slight tendency towards cryolite, possibly as this is used in the extraction of aluminium from aluminium oxide.

Q1(b)(ii)

This question provided a chemical equation showing the reaction of aluminium oxide with aqueous NaOH and needed to be balanced.

Half of the learners were able to offer one side of the equation correctly balanced. This was generally for placing "2" in front of the product formula, as the left hand side was already partly balanced and clearly showed two NaOH.

(ii) Equation 1 shows a reaction of aluminium oxide.

Al_2O_3 + 2 NaOH + ...2..... H_2O → .....2..... $NaAl(OH)_4$

Equation 1

Lead Examiner comment: *1 mark – the left hand side is incorrect, but the right hand side is correct.*

It was common to observe in responses awarded only 1 mark that either 2 or 4 had been placed in front of the water formula on the left hand side, and learners may have forgotten to take into account the presence of hydrogen in NaOH.

Just under quarter of learners correctly balanced the equation. Whilst learners can take any approach that they wish, a common feature of a successful answer showed working to arrive at the correct numbers.

(ii) Equation 1 shows a reaction of aluminium oxide.

Al_2O_3 + 2 NaOH + ...3..... H_2O → .....2..... $NaAl(OH)_4$

Equation 1

Add numbers to balance Equation 1.

(2)

Lead Examiner comment: *2 marks – the response shows the correct balancing of the equation, which the learner has clearly worked out.*

Centres must ensure that this basic of chemical skills is practiced thoroughly and frequently throughout the teaching of the subject. Centres must also include ionic and half equations to ensure that learners are fully prepared for these as well.

Q1(b)(iii)

This question continued to explore the acid-base characteristics of aluminium oxide and other metal oxide / hydroxides. The question gave some key information about how aluminium oxide and calcium oxide react with acids or alkalis, and in particular sodium hydroxide. Although learners completed the table readily, very few were able to correctly show that they knew or understood the characteristic of all of the compounds listed.

compound	acid	base
aluminium oxide	☒	☒
calcium oxide	☒	☒
sodium hydroxide	☒	☒

Table 1

3 marks

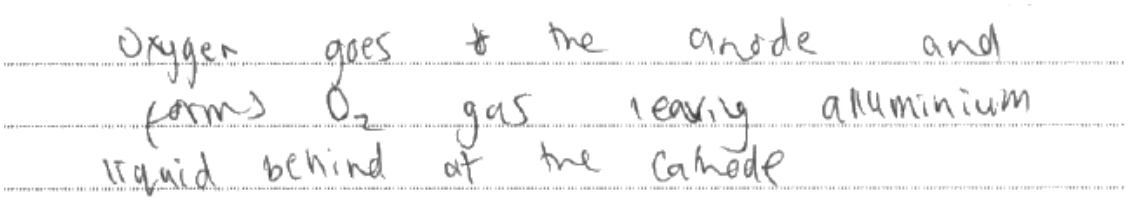
Even classifying two of the compounds correctly seemed to be challenging for most, with only a further 25% of learners being able to achieve this. In general, these learners were able to show aluminium oxide as having acid and base character, and one of the others as being a base.
The majority of learners were able to score 1 of the 3 marks, but quite often this appeared to be more good fortune than judgement as all three had base character to some extent.

Despite the supporting contexts within the question, learners should already be well aware of the amphoteric nature of aluminium oxide from their study of this unit. They must also know that it is more the exception than the rule and, in general, metal oxides and hydroxides are bases.

Q1(c)(i)

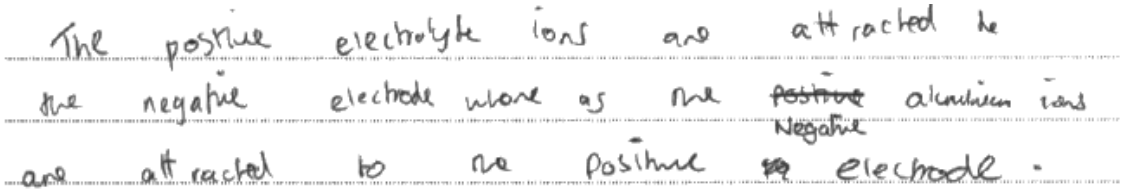
This question was not well answered in general with only just a few learners scoring any mark.

Learners often did not really appreciate the focus of the question was upon how exactly aluminium was produced, and did not tailor their response accordingly. Many would repeat aspects that were already established in the question context, such as the use of aluminium oxide, the use of electrolysis or that aluminium was shown at the negative electrode in the diagram. Others would provide information relevant to the extraction but not to the production of aluminium, such as the addition of cryolite, syphoning off the aluminium or how oxygen was produced.

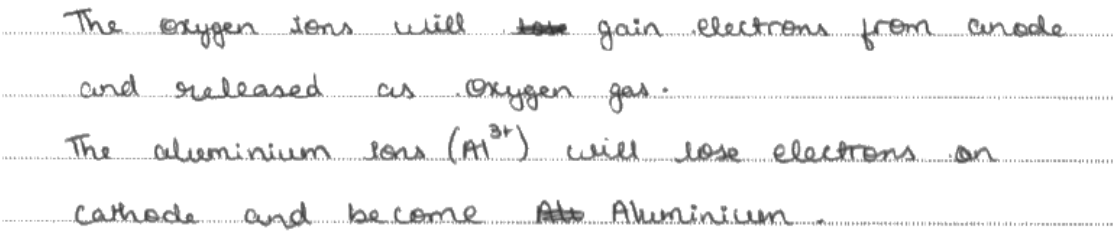


Lead Examiner comment: *0 marks – the response focuses upon the loss of oxygen as the reason for the aluminium being produced.*

Another broad group of responses simply demonstrated poor scientific knowledge. Confusion between molecules and ions, the type of charge and whether it involved loss or gain of electrons was common.


The positive electrolyte ions are attracted to the negative electrode more as the ~~positive~~ Negative aluminium ions are attracted to the positive ~~no~~ electrode.

Lead Examiner comment: *0 marks – the response identifies aluminium ions as negative and being attracted to the positive electrode in spite of the diagram that was provided.*

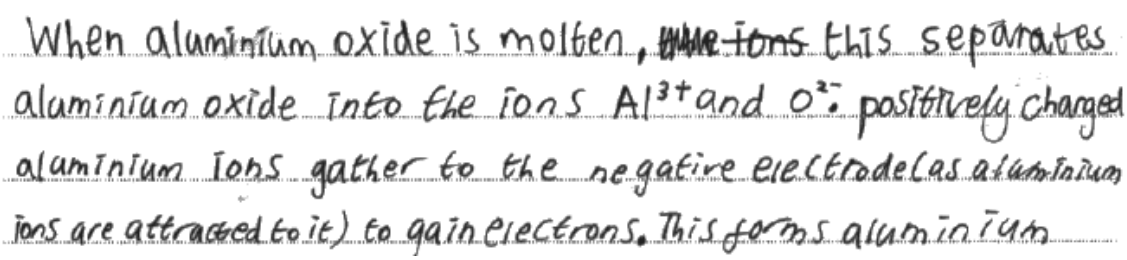

The oxygen ions will ~~lose~~ gain electrons from anode and released as Oxygen gas.
The aluminium ions (Al^{3+}) will lose electrons on cathode and become ~~Alo~~ Aluminium.

Lead Examiner comment: *1 mark – the response gives the charge of the aluminium ion but gives an incorrect direction of electron transfer.*

The best responses recognised that aluminium ions were positively charged and so were attracted to the negative electrode where they accepted electrons.

(i) Describe how electrolysis can be used to produce aluminium from aluminium oxide.

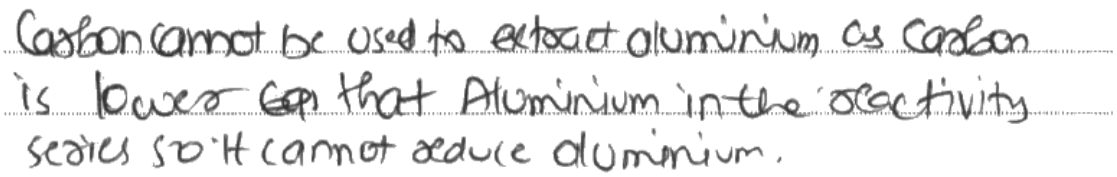
(2)


When aluminium oxide is molten, ~~the ions~~ this separates aluminium oxide into the ions Al^{3+} and O^{2-}. positively charged aluminium ions gather to the negative electrode(as aluminium ions are attracted to it) to gain electrons. This forms aluminium

Lead Examiner comment: *2 marks – this response is a comprehensive answer, revealing a good understanding of the process. Full marks are awarded for the identification of the formula of the aluminium ion, its attraction to the negative electrode and gain of electrons.*

Q1(c)(ii)

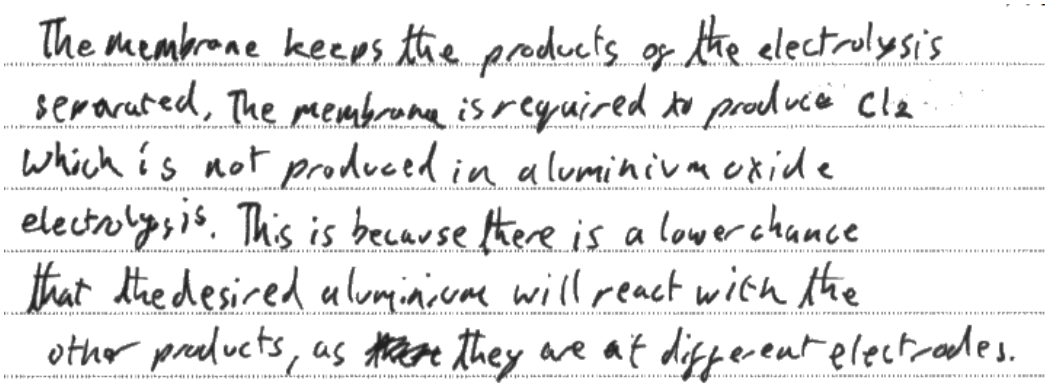
Reasons for the use of electrolysis in order to extract aluminium rather than reduction with carbon were poorly expressed or judged. Many responses focused upon an increased yield or speed, rather than there being a lower energy requirement or that aluminium was more reactive than carbon.


Carbon cannot be used to extract aluminium as Carbon
is lower on that Aluminium in the reactivity
series so it cannot reduce aluminium.

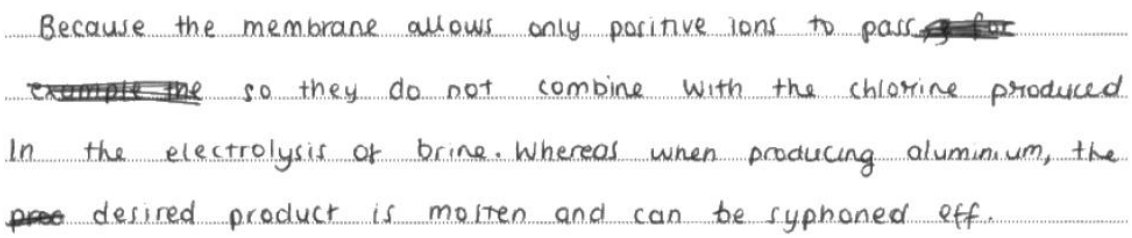
Lead Examiner comment: *1 mark – the response correctly identifies carbon as being lower in the reactivity series than aluminium.*

Q1(c)(iii)

This question was not well answered, with only just under quarter of the cohort scoring any mark, but it was intended for the better learners. Recall of why a membrane was used in the electrolysis of brine was required. Many learners would seem to have some knowledge of why, but were either unable to apply this to the context of the question or were just unable to express this clearly for a mark.

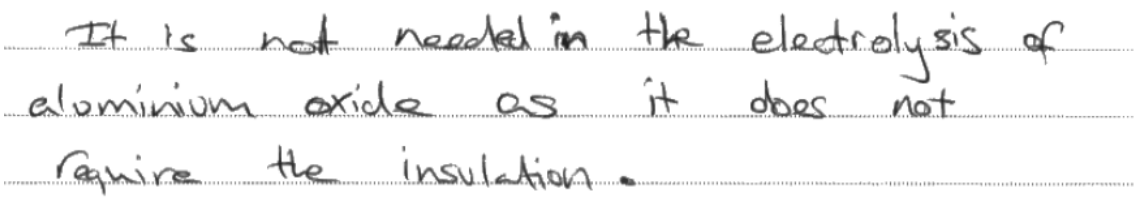

The membrane keeps the products of the electrolysis
separated, The membrane is required to produce Cl2
which is not produced in aluminium oxide
electrolysis. This is because there is a lower chance
that the desired aluminium will react with the
other products, as they are at different electrodes.

***Lead Examiner comment*:** *1 mark – the response that a membrane is needed in the electrolysis of brine to keep the products separate. However, further reasoning is too ambiguous, as aluminium will react with the "other product" and there being a "lower chance" is vague.*


Because the membrane allows only positive ions to pass
so they do not combine with the chlorine produced
In the electrolysis of brine. Whereas when producing aluminium, the
desired product is molten and can be syphoned off.

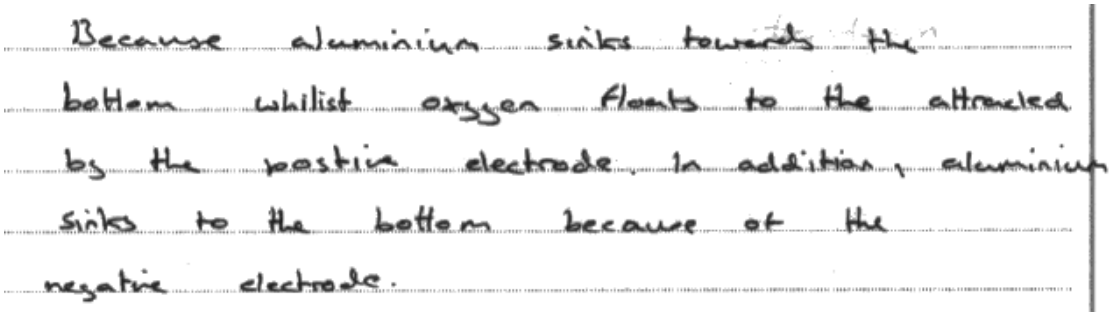
Lead Examiner comment: *1 mark – the response shows alternative purpose for a membrane in the electrolysis of brine. However, the reasoning for a second mark (ie aluminium is molten and syphoned off) is also not strong enough for further credit.*

Other learners simply provided odd reasoning such as the presence of insulation or that the electrolyte was molten and not aqueous meant that a membrane was not required. Whilst incorrect, it was good to see that these learners were attempting to seek answers from the diagram. There is often a prompt or clue to be found within diagrams or contexts, learners should be coached to analyse information provided rather than rely solely upon their own knowledge.



Lead Examiner comment: *0 marks – the response implies that a membrane provides insulation. Whilst incorrect, the learner has attempted to use the diagram to suggest a reason, which should be encouraged.*

Some learners were able to score their mark by simply observing that aluminium had sunk to the bottom of the cell or that oxygen floated to the top of the cell, therefore implying that a method of separation was not necessary.


Because aluminium sinks towards the
bottom whilist oxygen floats to the attracted
by the positive electrode. In addition, aluminium
sinks to the bottom because of the
negative electrode.

Lead Examiner comment: *1 mark – the response indicates that oxygen and aluminium are separated from each other at the top and bottom of the cell. This could have been expressed as differences in state of matter or density.*

In general, it was rare to see a learner state why a membrane was needed for the electrolysis of brine and then explain why it was not needed to keep aluminium and oxygen separate.

Q2(a)

A fair proportion of learners provided a suitable ending to the sentence that the energy and matter could be exchanged between a system and its surroundings. Incorrect answers generally attempted to say something about the reaction, such as the reactants, products or substances involved. This is core knowledge that learners must be clear and comfortable to express.

Q2(b)(i)

Only a small number of learners were able to identify a feature of the equations that would mark these out as representing the standard enthalpy change of combustion. A range of valid responses were observed. It was common for learners to refer to carbon dioxide and water as products, complete combustion, excess oxygen or 1 mole of a reactant being used. These learners showed a good knowledge and application to the examples given. Some, but only a few, learners provided a definition of the standard enthalpy change itself – this was credited although there was little specific linkage to provided examples (ie one mole of “substance” rather than heptane / octane is burned).

(i) Give **one** reason why Equation 2 and Equation 3 show the standard enthalpy change of combustion.

(1)

~~This~~ It is due to the reaction taking place with an excess of oxygen

Lead Examiner comment: *1 mark – the response indicates excess oxygen is used (which can be correctly inferred by the products being carbon dioxide and water).*

Because one mole of each substance burns completely in oxygen to make carbon dioxide and water

Lead Examiner comment: *1 mark – this response is fairly comprehensive with its reasons, and is based closely upon the definition for standard enthalpy change of combustion. However, naming of the substances burned would be desirable to link to Equations 2 and 3.*

Some learners that did not score tended to do so because there was insufficient detail in their answer.

because it reacts with oxygen.

Lead Examiner comment: *0 marks – this response would need to have indicated a complete reaction with oxygen or that it reacts with excess oxygen.*

carbon dioxide is produced.

Lead Examiner comment: *0 marks – this response only refers to carbon dioxide with no reference to water.*

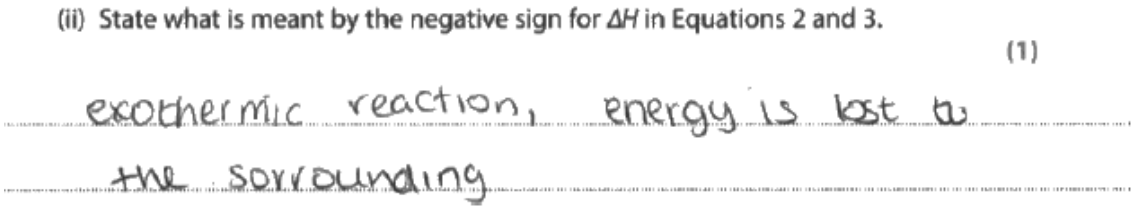
Many responses that did not score seemed to be answers to other parts of the question that were being used again by learners for Q2(b)(i). It was common to see reference to the equations being exothermic or equivalent wording. Whilst ΔH values are given, this was not shown by the equation itself, and these responses were likely prompted by it being the next focus.

Other responses tended to focus on standard conditions. Whilst this is a necessity for the standard enthalpy change of combustion, it is again not something that is shown in the equations. Both this and an exothermic enthalpy change are not unique to combustion and do not show sufficient linkage to examples, which learners should be encouraged to look for.

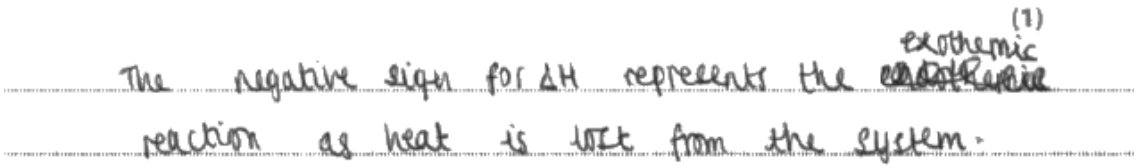
Lead Examiner comment: *0 marks – whilst standard conditions are necessary, it cannot be inferred from an equation that 100kPa and 298K have been used. Additionally, the learner has referred to "elements", suggesting that they have confused the standard enthalpy change of combustion with that of formation.*

Q2(b)(ii)

Just over a third of learners were able to identify that the negative sign for ΔH represented an exothermic reaction. Some learners gave a description of the direction in which the energy was transferred, which showed good knowledge.


(ii) State what is meant by the negative sign for ΔH in Equations 2 and 3.
(1)
exothermic reaction, energy is lost to
the sorrounding

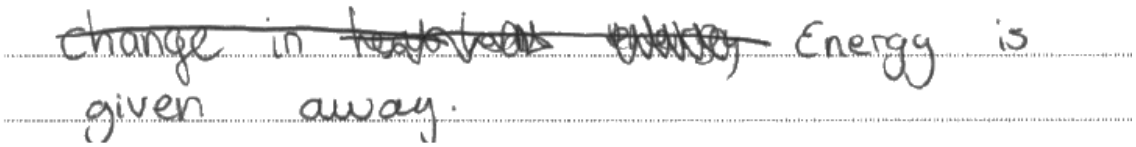
1 mark



1 mark

Lead Examiner comment: *Both of these responses identify that the enthalpy change is exothermic, which alone would be sufficient for the mark. Equally, there is sufficient information about the direction of energy transfer for the award of the mark had this been the only statement.*

A number of responses misinterpreted the question, simplistically saying that the value was less than zero or that ΔH meant enthalpy change, rather than state what the negative sign represented. However, more often than not, responses failed to score because there was a lack of clarity in the statement.

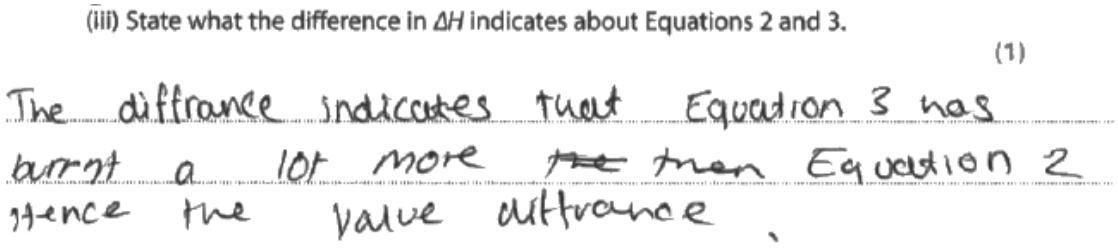


Lead Examiner comment: *0 marks – this response is poorly expressed and there is no indication of which direction energy is transferred to or from.*

Lead Examiner comment: *0 marks – this response is also poorly expressed and confused, beginning with the implication that energy is negative. The response then states energy is lost but not from where. A further point that energy is removed from the products offers no valid clarification.*

Q2(b)(iii)

This relatively straight forward question was also misinterpreted or poorly expressed by the majority of learners.


(iii) State what the difference in ΔH indicates about Equations 2 and 3.
(1)
The diffrance indicates that Equation 3 has
burnt a lot more ~~me~~ than Equation 2
hence the value diffrance.

Lead Examiner comment: *0 marks – a vague response which has focused upon what has burned or how much rather than offering comparison of the enthalpy changes.*

Octane has a lower combustion than heptane.

Lead Examiner comment: *0 marks – a brief response which would still not address the question even if it had clearly stated that the enthalpy change of combustion of octane was lower.*

~~octane~~ the difference is -1225 kJ

Lead Examiner comment: *0 marks – the learner has determined a value for the difference in enthalpy change but has not used this in a way to indicate what this represents.*

In the main, learners did at least try to offer a comparison of the reactions even if they did not really do so in the correct way. Nevertheless, only a small number of learners were able to clearly state that the combustion of octane was more exothermic than the combustion of heptane (or words to that effect).

(iii) State what the difference in ΔH indicates about Equations 2 and 3.

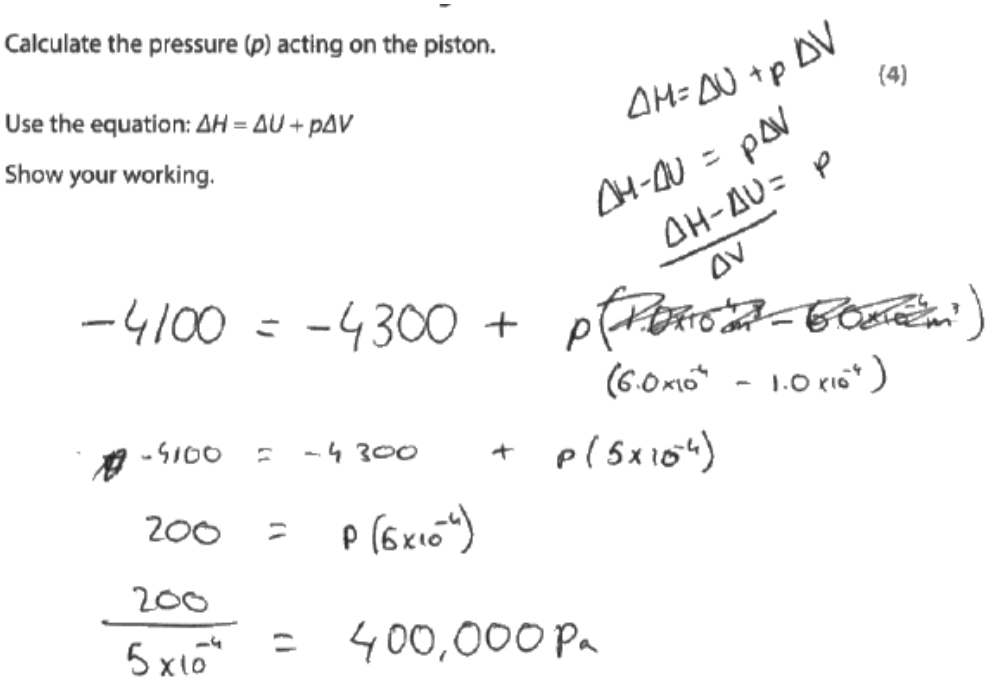
(1)

More energy was produced in equation 3, the combustion of octane

Lead Examiner comment: *1 mark – this response succinctly states that more energy was produced from Equation 3 / combustion of octane. This stands as a comparison without having to make reference to the other equation, and is sufficient as an interpretation of the difference between enthalpy changes.*

Q2(c)

The calculation of the pressure on a piston during combustion gave a wide range of answers and overall scores were evenly distributed from 0 to 4 marks.


Calculate the pressure (p) acting on the piston.
(4)
Use the equation: ΔH = ΔU + pΔV
Show your working.
ΔH = ΔU + p ΔV
ΔH − ΔU = pΔV
(ΔH − ΔU) / ΔV = p
−4100 = −4300 + p(6.0×10⁻⁴ − 1.0×10⁻⁴)
−4100 = −4300 + p(5×10⁻⁴)
200 = p(5×10⁻⁴)
200 / 5×10⁻⁴ = 400,000 Pa

Lead Examiner comment: *4 marks – this response shows clear working leading to the correctly evaluated answer of 400,000 Pa. Values have been substituted into the provided equation and rearranged, including a correct calculation of the change in volume.*

Most learners scored marks for correctly calculating the volume change or for substitution into the equation. Occasionally, learners would calculate a negative value for volume change. The presence of negative signs for the enthalpy and internal energy changes was a more frequent issue for some learners in their substitutions and would lead to problems later on. However, it was the rearrangement of the equation that proved to be the most problematic procedure, possibly as this did not fit neatly into a formula triangle, and consequently impacted upon a successful evaluation.

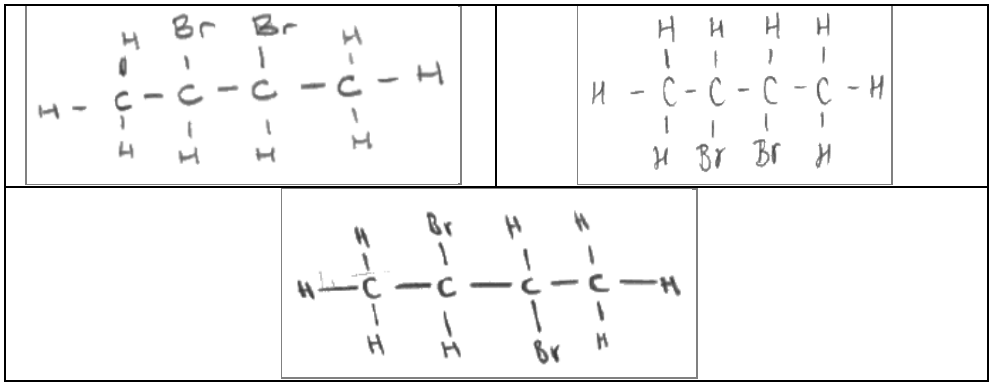
Q3(a)(i)

Q3 focused upon the electrophilic addition reactions of *cis*-but-2-ene.

Q3(a)(i) was multiple-choice question which tested whether learners could identify the name of the product formed from *cis*-but-2-ene and water. Just over half of the learners correctly identified butan-2-ol as the name. Of the other options selected there was a slight tendency towards butan-3-ol, as when counting from left to right, the OH group would appear to be on the third carbon.

Q3(a)(ii)

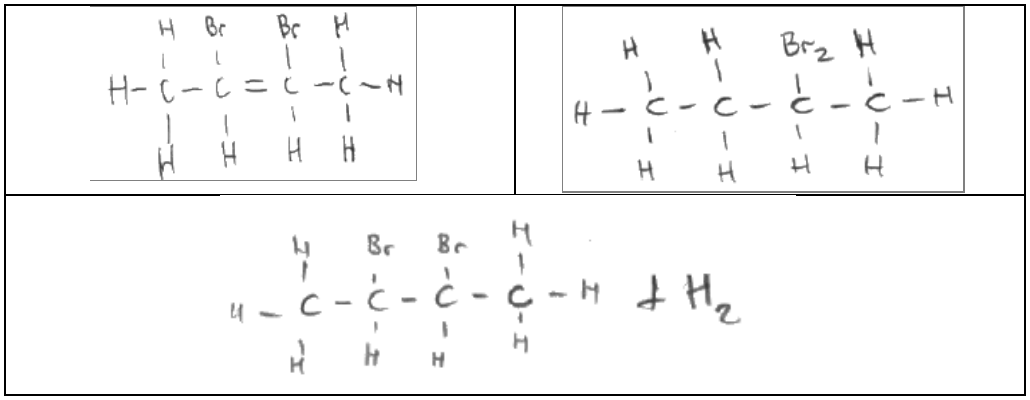
Learners needed to complete aspects of the reaction scheme shown in Figure 4. In Q3(a)(ii), the structural formula of 2,3-dibromobutane needed to be drawn. A little over a third of the cohort were able to do this correctly.



Lead Examiner comment: *1 mark - a selection of responses representing creditworthy structural formulae.*

Common errors observed were:

- drawings of 1,2 or 1,3-dibromobutane
- bromine atoms on the same carbon
- an OH group on the carbon chain
- the double bond remaining intact
- additional products being formed, such as H_2
- only one bromine atom or the Br_2 molecule on the carbon chain



Lead Examiner comment: *0 marks - a selection of responses representing errors observed.*

The errors shown would suggest that a large number of learners did not really know basic principles of organic chemistry, such as compounds of carbon having 4 bonds or how to complete addition reactions. The scheme in Figure 4 gave plenty of examples of *cis*-but-2-ene addition reactions which should have helped to reinforce these concepts. Organic chemistry is a major theme on this paper, which learners need to be well prepared for. They should also be encouraged to seek assistance offered by figures and diagrams where presented in a question.

Q3(a)(iii)

In common with Q3(a)(ii), learners needed to deduce a formula, but in this case it was of the reagent added to *cis*-but-2-ene to form butyl hydrogen sulfate. Many responses gave $HOSO_3H$ as the answer, which was acceptable and revealed a good understanding of the scheme shown in Figure 4. A smaller but significant number of learners gave the formula as H_2SO_4, either deciding to represent the formula conventionally or demonstrating good subject knowledge of this particular reaction. Generally, it was observed that the learners that had correctly drawn the structural formula in Q3(a)(ii), also achieved the mark here. Where learners attempted the question but did not score, this tended to be because the formula was missing one H or O atom. This was again likely to be a consequence of poor understanding of addition reactions / Figure 4.

Lead Examiner comment: *0 marks – in this response, the learner has failed to include an additional H. This could have been deduced from the structural formula provided in Figure 4.*

Q3(b)(i)

The questions under Q3(b) focused on electrophilic addition, requiring a good understanding of the mechanism. Q3(b)(i) revealed that many learners did not know what an electrophile is or just could not express their thoughts coherently. Nevertheless, this was a problem intended for better learners. Just over a quarter of learners appreciated that an electrophile was attracted to / accepted electrons, or that it had a positive charge or dipole. Some learners provided a literal translation that it was "electron loving", which was a good approach but should have been expressed scientifically. It was rare to see that a learner knew that a pair of electrons were accepted to form a new covalent bond.

(i) Explain what the word 'electrophile' means.

(2)

electrophile means that it is able to accept electrons

Lead Examiner comment: *1 mark – in this response, the learner understands that an electrophile will accept electrons. It does not reveal any depth of understanding regarding the species or bonding. This is a weak response but sufficient to be credited a mark.*

Electrophile means that the element is attracted to electrons

Lead Examiner comment: *1 mark – the response indicates attraction to electrons and therefore suggests an understanding of the nature of an electrophile. Although the reference to "element" is not accurate, it has been ignored.*

A slightly positive ion that attacks an area of high negative charge in the double covalent bond of ~~alkene~~ alkenes.

Lead Examiner comment: *1 mark – this response reveals a better and clearer understanding in relation to the context of electrophilic addition. Again, the use of "slightly" positive ion is inaccurate but does not detract from the central point made by the learner.*

an electron deficient species which can accept a lone pair of electrons.

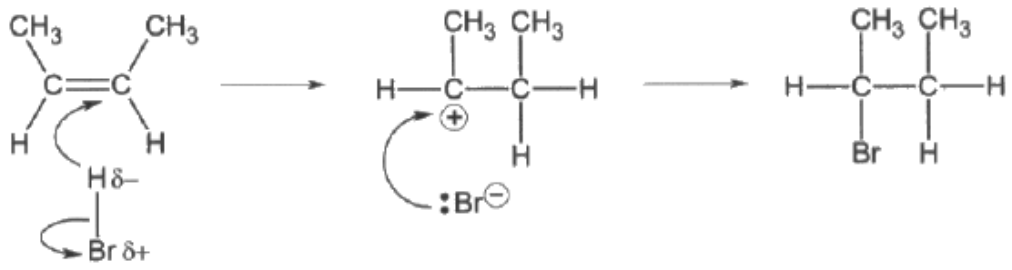
Lead Examiner comment: *2 marks – in this response, the learner has given a concise definition of the term to score both marks. The use of "electron deficient species" is suitably broad and well-judged. Note that it is the acceptance of a "pair" of electrons that is important here for the second mark rather than the type.*

Common misconceptions observed in responses that did not score were:

- the involvement of electricity or electrolysis
- electrophiles losing or giving away electrons
- electrophiles starting or initiating a reaction
- reference to positive electrons.

Q3(b)(ii)

A significant number of learners scored 1 or 2 marks for the identification of errors in Step 1 of the mechanism, although more than half did not score anything at all. A typical reason for this would be a lack of accuracy in a learner's identification, such as the curly arrow pointing in the wrong direction but not indicating which arrow, or that the arrow should be pointing at the bond and not the atom. Occasionally, learners would stray to discuss Step 2 which did not contain any errors.



Step 1 **Step 2**

Figure 5

There are two errors in Step 1 of the mechanism.

Explain the **two** errors in Step 1 of Figure 5.

(4)

1 the charges of the HBr are wrong, ~~it~~ the H should look like $H^{\delta+}$ as it is slightly positive charge and $Br^{\delta-}$ as it a slightly negative charge.

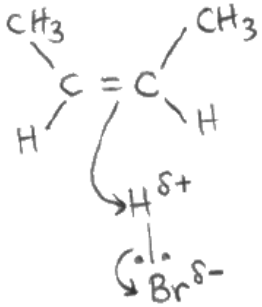
2 the ~~curly~~ curly arrow is facing the wrong way between the cis-but-2-ene and $H^{\delta+}$

Lead Examiner comment: *2 marks – in this response, the learner has identified both errors correctly and clearly. However, there is no explanation of why the dipole or the curly arrow is the wrong way around to secure further marks.*

Very few learners scored 3 or more marks for an explanation of the errors, but these last two marks were intended for the very best learners. In order to access these marks, learners needed to ensure that they were fully addressing the command verb, which was generally not the case.

1 Bromine should be slightly negative, as it is the most electronegative and takes the pair of electrons in the homolytic fission.

2 The arrow should not go from hydrogen to the double bond, but the other way around, as carbon takes in the hydrogen atom. It should be:



Lead Examiner comment: *3 marks – in this response, the learner has identified both errors correctly and clearly. In the first part, there is good scientific reasoning for why bromine is slightly negative, but an adequate explanation is missing from the second part. A corrected diagram is provided by the learner, demonstrating their understanding and would have alternatively secured the identification marks.*

Q3(b)(iii)

In this multiple-choice question, learners had to identify the most stable carbocation. Just under quarter of the learners correctly identified option C. In order to correctly answer this question, learners would need to understand that the correct structure was the one that had the most alkyl groups attached directly to C.

Q3(c)

This question explored symmetry in different isomers of butene and the resulting products when HBr was added. It targeted stronger learners, requiring a good level of clarity and reasoning, yet all learners should have been able to make some valid points in connection with the structures. However, it was common to see responses discuss aspects which were not relevant such as geometric isomerism, sigma

and pi orbitals, bond strength, chain length and restricted rotation about the double bond. In addition to being incorrect, this also betrayed poor understanding of these areas by many learners.

The most commonly achieved mark was to identify that but-1-ene was an asymmetrical alkene (or that *cis*-but-2-ene was symmetrical). These were not terms that many learners used, preferring to describe the differences between the isomers, which had mixed results.

When HBr is added to but-1-ene, two products are formed.

When HBr is added to *cis*-but-2-ene, only one product is formed.

Explain why but-1-ene can form **two** products, but *cis*-but-2-ene can only form **one** product.

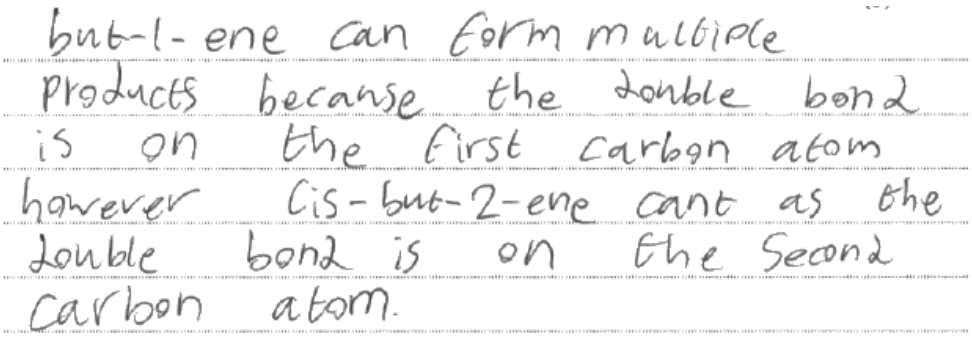
(3)

This is because cis-but-2-ene is symmetrical unlike but-1-ene which is unsymmetrical

Lead Examiner comment: *1 mark – the learner has commented on the symmetry of the two isomers correctly.*

But-1-ene has has the double bond on the 1st to 2nd carbon meaning it can be split and made into two product. where as the double bond on the cis-but-2-ene is inbetween the 2nd to 3rd carbon meaning it can only form one product.

Lead Examiner comment: *1 mark – the learner has attempted to describe the difference in the position of the double bond in the isomers in terms of carbon number. This is sufficiently clear and relevant to the answer. However, there is no other point that is creditworthy as the rest of the response just reiterates the question.*


but-1-ene can form multiple
Products because the double bond
is on the first carbon atom
however cis-but-2-ene cant as the
double bond is on the second
carbon atom.

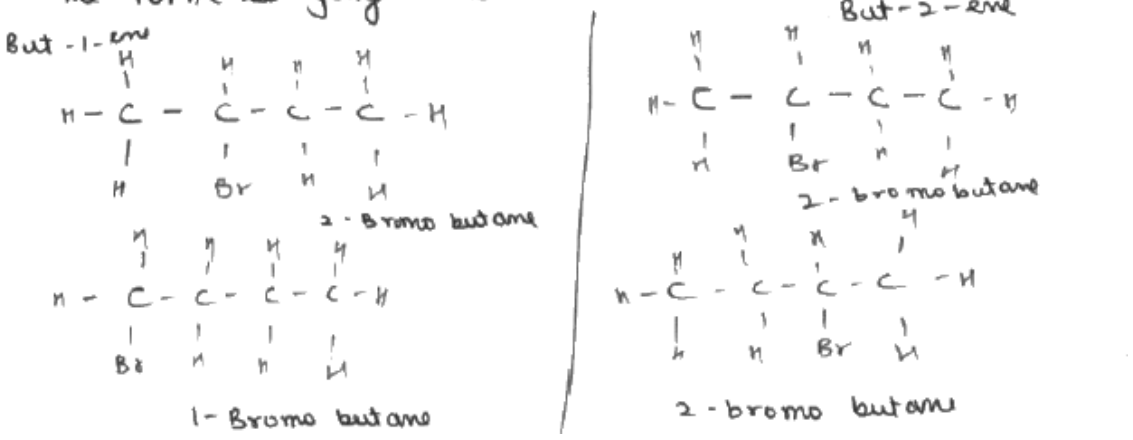
Lead Examiner comment: *0 marks – this response also attempts to identify the position of the double bond in each isomer but only refers to one carbon atom in each, which is not accurate enough (ie the second carbon is involved in the double bond of both isomers).*

Responses scoring 2 or 3 marks were rare, but showed good use of terminology and description to convey why a different number of products were obtained. The highest scoring responses tended to rely upon diagrams to explain ideas, to good effect. Learners would either draw the structural formulae of the products or would annotate the skeletal formulae of the butenes in order to support their explanations.

The reason why Cis but-2-ene only forms one product is because of its symmetry where as it have same groups attached to either of it's side where as but-1-ene gives two products because it is assymmetrical there are different groups attached on be either sides so ethophile chave chance to attact to any of the carbon in which = bond was there and the IUPAC of them will be different (Total for Question 3 = 13 marks)

(b/w =)

whereas no matter to which carbon etrophile attaches the IUPAC is going to be same.



Lead Examiner comment: *3 marks – the learner has described the difference in asymmetry between the two alkenes sufficiently for a mark. The rest of the written response focuses primarily on but-1-ene and is not entirely clear. However, structural formulae and names of products support this, and afford access to the other two marks.*

Learners have clearly found organic chemistry the most demanding area of Unit 5 Chemistry and do need to develop strategies to help themselves. The use of diagrams in organic chemistry, either provided within a question or drawn by learners, is not observed frequently enough as a means of working or supporting points within responses. This should be more strongly encouraged by centres when preparing learners.

Q4

This final question was an extended open response levels based question and required learners to discuss how iron and its ions behave as catalysts in the reactions given.

In terms of response, about 70% of the learners scored at least one mark, which was lower than in the previous series. This was somewhat surprising given that characteristics of catalysts are generally well known by learners. Most could give basic statements about the function of catalysts (eg speed up the reaction without getting used up, lowering the activation energy by providing an alternative pathway, etc) and so attained a mark in Level 1. The more features that were referred to, with a chain of reasoning, the higher the score achieved at this level.

4 Iron (Fe) is used as a solid catalyst in the Haber process reaction:

$$N_2(g) + 3H_2(g) \rightleftarrows 2NH_3(g)$$

Iron ions are used to catalyse the reaction between persulfate ($S_2O_8^{2-}$) and iodide (I^-) ions.

The catalysed reaction happens in two steps involving Fe^{2+} and Fe^{3+} ions.

Step 1: $S_2O_8^{2-} + 2Fe^{2+} \rightarrow 2SO_4^{2-} + 2Fe^{3+}$

Step 2: $2I^- + 2Fe^{3+} \rightarrow I_2 + 2Fe^{2+}$

Discuss how iron and iron ions behave as catalysts in these reactions.

(6)

Catalyst speeds up the reaction of any reaction. They can provide with alternative pathway for the reaction to happen. They also keep the activation energy low thus saving energy and keeping the boiling point low.

Lead Examiner comment: *Level 1, 2 marks - this response provides the key characteristics of a catalyst. This is generic with no connection to the context, however. The reference to boiling point is not relevant, but there is a little linking of ideas (lowers the activation energy so saves energy) but the lack of application restricts this response to Level 1.*

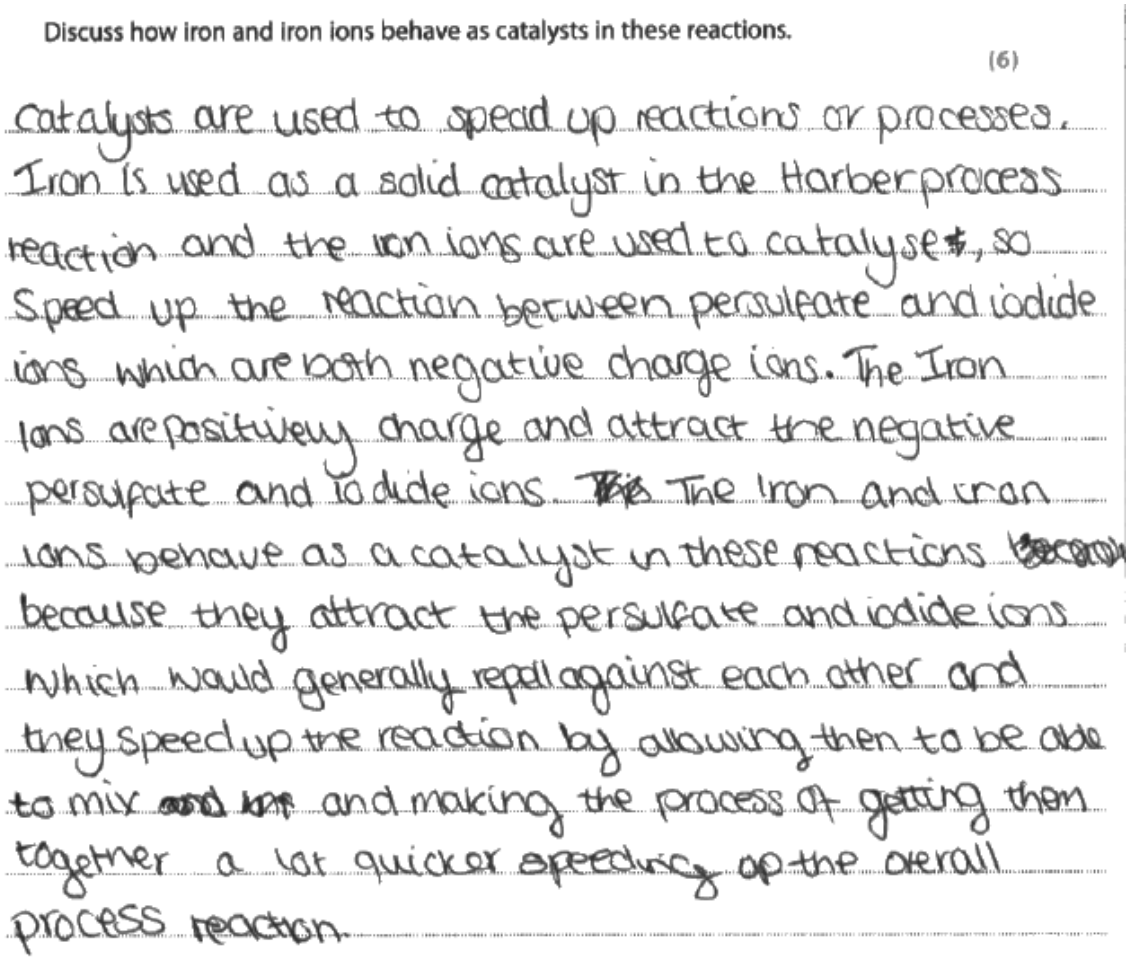
Responses that reached Level 2 also gave the function of catalysts but used this to give some idea of the role of iron in the reactions. Generally speaking though, this focused upon the persulfate-iodide reaction rather than the Haber process, despite this being the more familiar reaction. This was probably due to the "visibility" of the Fe^{2+} and Fe^{3+} ions in the equations, and it was not uncommon for this to be confused with the Haber process in some way. Consequently learners who gave a good, coherent explanation of the redox reaction, scored at the top of the level. Responses at the bottom of the level were confused in some respect, such as over which species was oxidised or reduced, poor terminology or coherence.

Discuss how iron and iron ions behave as catalysts in these reactions.

(6)

- Iron can react at different oxidation states due to it being a transition metal.
- Iron is able to loose and gain electrons easily to help speed up reaction.
- In step 1 iron looses ~~one~~ an electron to become $2Fe^{3+}$ instead of $2Fe^{2+}$ this means that it was lost due to it speeding up the reaction.
- In step 2 iron gains an electron by taking iodines making neutral meaning it can be diatomic again, resulting in iron to become less negatively charged.

Lead Examiner comment: *Level 2, 3 marks - the response starts well with the ability of iron to have different oxidation states and lose or gain electrons, but the rest of the response is a little confused in parts. There is correct reference to the ions of iron being involved but there could be greater discussion of the persulfate and iodide ions. There are also some odd expressions at points, such as iron forming ions and iron becoming less negatively charged. There is sufficient knowledge applicable to reaction 2 but a lack of coherency and occasional error is what prevents this from reaching the top of Level 2.*



Discuss how iron and iron ions behave as catalysts in these reactions.

(6)

Catalysts are used to speed up reactions or processes. Iron is used as a solid catalyst in the Harber process reaction and the iron ions are used to catalyse*, so speed up the reaction between persulfate and iodide ions which are both negative charge ions. The Iron ions are positively charge and attract the negative persulfate and iodide ions. ~~This~~ The iron and iron ions behave as a catalyst in these reactions ~~because~~ because they attract the persulfate and iodide ions which would generally repel against each other and they speed up the reaction by allowing them to be able to mix ~~and~~ and making the process of getting them together a lot quicker speeding up the overall process reaction.

Lead Examiner comment: *Level 2, 4 marks - this response begins with some general knowledge (catalysts speed up reactions) and information from the context (ie iron is a solid catalyst, iron ions catalyse the second reaction). The discussion that follows revolves around good chemistry regarding how positive and negative ions interact. It is relevant and provides a strong line of argument of how the reaction rate has been increased, even though an explanation involving redox would have typically been expected. However, there is little consideration of iron in the Haber process and a wider understanding of properties of a catalyst / iron is missing which would prevent a placing in Level 3.*

Responses that scored at Level 3 tended to use language that was more technically accurate (eg rate rather than speed of a reaction) and coherent.

More sustained lines of reasoning and depth were also characteristic, such as identifying the species that gained or lost electrons in the second reaction and the use of half equations. The Haber process uses iron as a heterogeneous catalyst, and it was occasionally noted as being solid, yet

it was rare to observe any learners refer to adsorption of gas molecules on the surface of iron and what was taking place. The main factor which tended to determine whether full marks were achieved or not, was whether there was sufficient discussion of both reactions being catalysed.

Discuss how iron and iron ions behave as catalysts in these reactions.

(6)

iron and iron ions act as catalysts by increasing the rate of a reaction by lowering the activation energy and providing an alternate pathway. Iron is a transition metal meaning it has variable oxidation states, which helps it act as a catalyst. Iron works by allowing the reactants to take the surface of the catalyst to increase collisions of particles and increase rate of reaction. The catalyst ~~is~~ iron is not used up in the reaction. instead it is formed meaning it can be used again. The iron catalyst oxidises the $S_2O_8^{2-}$ to form $2SO_4^{2-}$. This causes the catalyst to lose ~~gain~~ an electron as shown=> $Fe^{2+} \rightarrow Fe^{3+} + e^-$. It then reduces the $2I^-$ to form I_2. This means the iron ion gains the electron back as shown $Fe^{3+} + e^- \rightarrow Fe^{2+}$.

Lead Examiner comment: *Level 3, 5 marks - the response typically begins with generic points regarding catalysts (eg increases rate, lowers activation energy, variable oxidation state, etc), but here the technical language and structure is stronger. The role of iron is then discussed - it is not specific but suggests reference to the first reaction, the Haber process. There is some detail about how it provides a surface and offers some ideas about rate of reaction, although discussion about adsorption, reducing activation energy or energy to break bonds could have been included. The response moves on to discuss the second reaction, showing a reasonable understanding of redox and the use of half equations. However, there is an error as the learner indicates that persulfate is oxidised. There would also need to be a more relevant and complete discussion of the Haber process to achieve 6 marks.*

Summary

Based upon performance within this paper, it is recommended that learners:

- Know standard terms and conventions used in thermochemistry eg standard enthalpy change of combustion, exothermic and negative sign (A3)
- Know the acid-base characteristics of common metal oxides and hydroxides, or be able to determine these from given information (A1)
- Use simple working techniques to solve numerical problems eg keeping track of atom numbers when balancing equations, finding the “shortest route” to the position of a functional group on a carbon chain
- Understand the use of electrolysis, in terms of reduction and oxidation, electron transfer and the attraction of ions to specific electrodes (A1)
- Understand and apply ideas of catalysis to given contexts (A1). Learners should also be able to use more specialist terms, such as heterogeneous and homogeneous, describe mechanisms involving redox or adsorption (see the Additional Guidance document here for further details)
- Practice writing organic chemistry reactions, drawing structural formulae and naming of compounds (A3)
- Understand electrophilic addition mechanisms, including the use of key terms (A3). Learners should be prepared to discuss mechanistic points as well as draw mechanisms
- Practice questions of 2 or more marks that test knowledge and develop reasoning skills. For these questions, learners should begin with identifying the relevant feature (eg aluminum exists as positive ions in aluminium oxide, the position of a double bond or asymmetry of an alkene) and then provide further expansion upon the point.
- Use drawings to assist their explanations and clarify their ideas eg drawings of an electrophilic addition mechanism, products from the addition of HBr to butane
- Examine information presented in a question carefully, as this often provides support and ideas to access further marks eg image of drink

cans to suggest properties, diagram of electrolysis of aluminium oxide to suggest how products separate, a structured organic reaction scheme, etc

Individual Questions

Physics

Q1

This question tested knowledge and understanding of section C1 of the specification. Learners were expected to use their knowledge of key ideas and definitions to answer a series of short questions testing ideas relating to internal energy, the second law of thermodynamics, pressure and the kinetic theory and the equation pV = nRT.

Q1(a)

Learners were generally able to score this multiple-choice question that tested understanding of what internal energy was. Over half of the learners were able to answer the question correctly by giving the answer C. Common incorrect answers were either A or B.

Q1(b)

The question tested an understanding of the second law of thermodynamics. Learners were expected to complete the sentence by adding the missing word ‘entropy’. Very few learners were able to do this.

Q1(c)(i)

Learners were asked to explain why the pressure changes when the volume occupied by a gas increase. The answer had to be given in terms of the behaviour of molecules. Few learners were able to gain both marks in this two mark question, however most learners were able to state that the pressure decreased. The question was an ‘explain’ and so an expansion was expected, however very few learners were able to link the decrease in pressure to there being less frequent collisions of molecules with the walls of the cylinder.

Q1(c)(ii)

The final part of this question asked learners to use an equation that is part of the specification to calculate the temperature of a gas. Many learners were able to access these marks with the great majority scoring all three marks for a fully correct answer. Some learners did not rearrange the equation correctly; however, they were able to gain some marks for a correct substitution and then an evaluation. The values were deliberately given in non-standard form to remove that barrier in arriving at the answer, this did not stop some learners in trying to use standard form incorrectly. Centres are advised to tell learners that if the numbers are not given in standard form that it is inadvisable to try and convert values into standard form and thereby possibly introduce an error. The most common error was to wrongly rearrange the equation.

Q2

This question tested section C3 of the specification and looked at what the term 'viscosity' was, then asked learners to draw streamline flow and finally consider the application of Bernoulli's principle to a practically based scenario.

Q2a

This was a multiple-choice question that tested the meaning of viscosity. Learners answered correctly in large numbers, with the majority giving the correct answer D to the question.

Q2b

Learners were asked to draw lines between two sets of dots on the page to show a streamline air flow. The expectation was that learners would draw parallel straight lines between the dots. Learners needed to draw at least two lines to show the flow. Less than half of the learners able to do this. Where the mark was not scored, the most common reason was that lines were not parallel or that there were incomplete lines. Learners would have found scoring this mark easier had they had access to a ruler to draw the lines, although lines did not have to be perfectly straight, they did need to be approximately so.

Q2(c)

This was a question designed to test learners at the Merit/Distinction boundary. The question asked why the air flow between a lorry and a car moves them together when they are passing each other. It is an application of Bernoulli's principle; where having a constricted space, like that between the two vehicles, makes airflow faster. This reduces the air pressure between the vehicles, so there is a pressure difference between the air flow between the vehicles and the surrounding air. This finally creates a force pulling the vehicles together.

This response gained 3 marks

(c) Figure 3a shows a car just before passing a lorry.

Figure 3b shows the car passing the lorry.

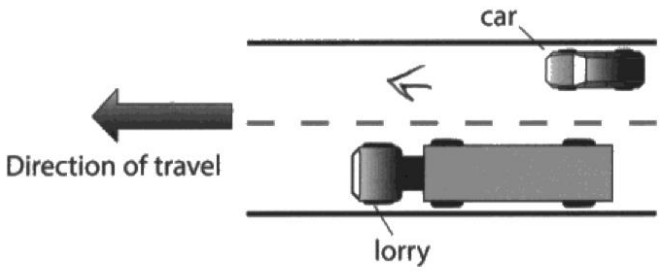


Figure 3a

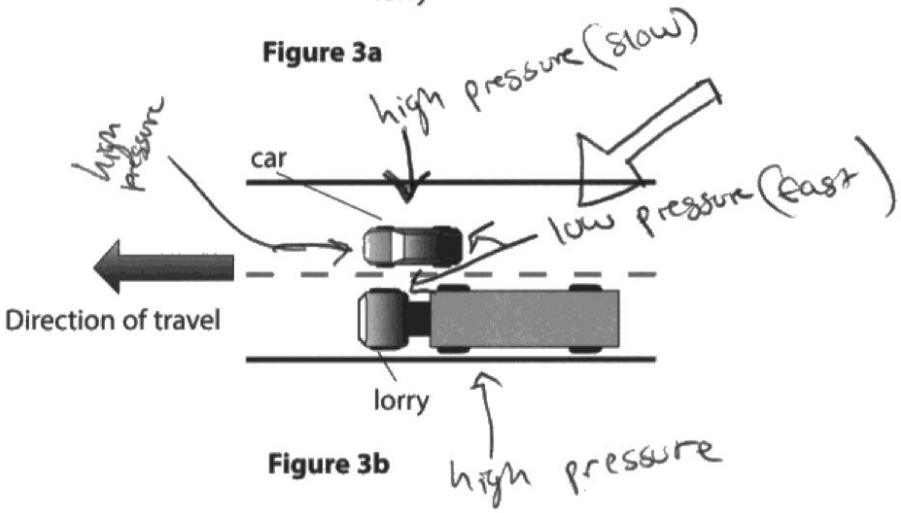


Figure 3b

As the car is passing the lorry, the air flow moves the car towards the lorry.

Explain why the air flow moves the car towards the lorry.

(4)

As the ~~ease~~ car pases the lorry the air that passes over the car creates a low pressure parallel to the lorry, the low pressure causes the car to speed up in the direction of the lorry. The same thing happens for the lorry (low pressure passes over it). The lorry is also blocking some of the air, there is no pressure acting on the side of the car as the lorry is sheilding it. The air ~~pass~~ pressure creates an uplift in the direction of the lorry.

(Total for Question 2 = 6 marks)

Lead Examiner comment: *The diagram was very helpful in clarifying with well-placed labels what was happening in this situation. The diagram allows the award of the first expansion marking point, where the label indicates the region of low pressure. The diagram also shows that the air pressure is high on each side of the two vehicles and the labels 'fast' and 'slow' indicate information about air flow, together with the first two lines of the answer overall a good three mark answer is produced.*

The only marking point missing is the last expansion point which relates the pressure difference to a force being present.

Answers such as this were very rare. In most cases learners identified that the air between the vehicles was flowing in the opposite direction to the vehicles or was flowing faster and left it at that.

Q3

This question covers parts of section C1 in the specification, looking at the ideas of heat engines and the efficiency of a thermal system. The final question was a calculation based on a heat engine.

Q3(a)

This question asked learners to describe what a heat engine does. Many learners wrote about heat pumps and so missed the point. The question was not well answered, and many learners struggled with this description. Some learners were able to identify that the engine converts thermal energy to some other form but were unclear as to exactly what that was. A very few were able to give the full two mark answer.

This response gained both marks

3 A power station generates electrical energy.

A turbine in the power station is a heat engine.

(a) Describe what a heat engine does.

(2)

transfers heat energy into mechanical energy or useful energy. never 100% efficient.

Lead Examiner comment: *The word 'heat' was acceptable for 'thermal' and 'mechanical energy' was acceptable for 'kinetic energy'. The last part was ignored.*

Q3(b)

The question asked learners to compare two turbines under specific conditions and then explain the advantage of using one rather than the other. A fair number of learners were able to make the identification that turbine A was more efficient, however very few could then go on to offer an expansion of this by stating that more energy is converted to useful or, or less energy is wasted.

This response was a clear 2 mark answer

(b) Steam enters two identical turbines at the same temperature.

The temperature of the steam leaving turbine A is lower than the temperature of the steam leaving turbine B.

Explain the advantage of using turbine A rather than turbine B.

(2)

Turbine A is more effective because less heat is lost to the surroundings as it isn't as hot as turbine B.

Lead Examiner comment: *This response was awarded the identification mark and the final point from the mark scheme for this question.*

Q3(c)

The final part of Q3 was a calculation based on one of the efficiency equations given in the specification, in this case for a heat engine. Many learners were able to access this question with over half being able to score at least one mark. The question requires learners to be able to rearrange an equation where there is a -1 included in the formula. In past series this gave learners great difficulty. It was pleasing to see that this was not so much the case in this examination.

The following answer scores all 3 marks

(c) The power station has an efficiency of 0.45.

The output energy is 1.2×10^9 J.

Show that the input energy is approximately 2.0×10^9 J. (3)

Use the equation: Efficiency = $1 - \frac{Q_{out}}{Q_{in}}$

Show your working.

$E = 0.45$

Output $= 1.2 \times 10^9$

Input $= ?$

$0.45 = 1 - \frac{1.2 \times 10^9}{?}$

Input $= 1 - 0.45 = 0.55$

$= \frac{1.2 \times 10^9}{0.55}$

$= 2.2 \times 10^9$

input energy = 2.2×10^9 J

Lead Examiner comment: *The answer is set out clearly showing all the steps. Centres are encouraged to advise learners that this approach would help them in setting out an answer in a logical way.*

Q4

This question tested section C1 of the specification. The particular section of the specification related to kinetic theory applied to the process of evaporation and change of state and also the use of the relationship. Q = mL in a calculation.

Q4(a)(i)

Learners were asked to name the process that makes a puddle disappear. Majority of learners were able to answer this correctly with the answer 'evaporation'. It was pleasing to see this piece of recall of information was well understood.

Q4(a)(ii)

Learners were asked to describe how the puddle disappears. Many learners were able to write that the water molecules gain energy or moved faster, thus gaining a mark. A tiny number of learners were able to go on to describe from where the molecules escaped, which was the surface of the puddle.

Q4(b)(i)

This calculation tested the use of the formula Q = mL. Most learners were able to gain at least one mark, with a large number scoring two marks or the full three marks.

This response gained 3 marks

(b) (i) A pan of water is heated.

2.00×10^6 J of energy is used to change some water into steam.

The water and steam are at the same temperature.

The specific latent heat of vaporisation of water is 2.26×10^6 Jkg^{-1}.

Calculate the mass of water changed to steam.

(3)

Show your working.

$Q = m c \Delta T$

$m = \frac{Q}{c \Delta T}$

$Q = 2 \times 10^6$

$m = ?$

$c = 2.26 \times 10^6$

$\Delta T = 0$

$\frac{2 \times 10^6}{2.26 \times 10^6 \times 0} = 0.884$ 0.89

mass of water changed to steam 0.89 kg

Lead Examiner report: *The answer is set out clearly with full working shown. The answer has been rounded to 2s.f. which was not asked for, but is fully correct. Many learners that did not score full marks wrongly rearranged the equation or were not able to express the answer to the correct power of ten.*

Q4(b)(ii)

This question asked learners to explain why water temperature does not change at boiling point. This was a challenging question that gave very few one mark answers and even fewer full mark answers.

This answer scored 2 marks

(ii) Explain why the temperature of the water stays at 100 °C when changing from water into steam.

(2)

As a substance, such as water, changes state, only potential energy is increasing. Kinetic energy doesn't change, hence why temperature doesn't change either.

Lead Examiner comment: *The learner has given the first marking point and the last marking point. Such clear answers were rare. Many incorrect answers were about the water turning to steam or repeating the question stem.*

Q5

This final question on the paper covered topics in section C2 of the specification. In particular the units of measurement for Young's Modulus, the definition of the term 'ductile', a calculation based on one of the equations learners are expected to know in the section, in this case the one related to work done in stretching a spring and finally a question relating to the elastic and plastic properties of different materials.

Q5(a)

This multiple-choice question asked learners to identify the unit of measurement for Young's Modulus. The question discriminated well and more than half of the learners were able to identify correctly that B was the unit.

Q5(b)

This was the final multiple-choice question in the paper and asked learners to identify a property of a material. This question was answered correctly by just under half of the learners. The answer B 'ductility' was correct. Many learners gave the answer C 'malleability' confusing the two terms.

Q5(c)

This calculation was a good discriminator of ability, most learners were able to score at least one mark with many scoring two marks. The full four marks was scored by a much smaller number of learners, which was to be expected given that one of the marks was targeted at Distinction.

This answer scored 4 marks

(c) A learner applies a force to stretch a steel spring. ÷100

The stretch, Δx, of the spring is 65 cm. 65cm → m 0.65m

The work done, W, in stretching the spring is 5.0 J.

Calculate the stiffness constant, k, for the spring.

(4)

Assume that the spring is not extended beyond its elastic limit.

Use the equation: $W = \frac{1}{2} k(\Delta x)^2$

Show your working.

$5.0 = \frac{1}{2} \times k\ (0.65)^2$

$\frac{5.0}{\frac{1}{2} \times (0.65)^2} = \frac{\frac{1}{2} \times k\ (0.65)^2}{\frac{1}{2} \times (0.65)^2}$

$k = \frac{5.0}{\frac{1}{2} \times (0.65^2)} = 23.668639\,0$

↳ 23.67

stiffness constant, k = 23.67 $N\,m^{-1}$

Lead Examiner comment: *The answer is set out well showing the conversion from cm to m at the top of the page through to the substitution, rearrangement, and evaluation at the bottom of the page. Few answers were as well set out as this. In many cases the conversion from cm to m was not done and/or the rearrangement was incorrect. Compensatory marks were available for learners who made errors as they worked through the calculation.*

Q5(d)

The last question on the paper was the six mark levelled question. This question discriminated well across the mark range. Many learners were able to score between one and two marks and the whole range of marks to six was accessed by the most able learners.

The question asked learners to compare two different materials for which the stress/strain graph had been drawn. Learners were asked to compare the similarities and differences in the elastic and plastic properties of the two materials. Learners were asked to annotate the graph to help in their answer and many learners did this. For a good number the annotations enabled learners to show higher levels of understanding.

This answer gained a Level 3 mark

(d) A steel wire and a strip of polythene bag are stretched by adding weights to each.

Figure 4 is the stress-strain graph for the steel wire and the polythene bag when weights are added and removed.

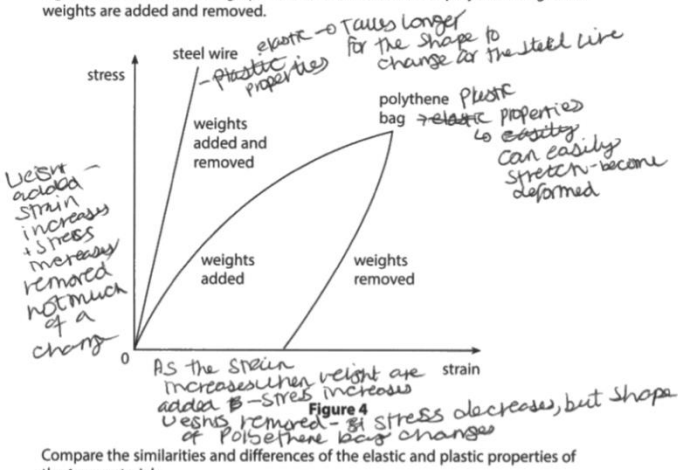


Figure 4

Compare the similarities and differences of the elastic and plastic properties of the **two** materials.

(6)

You can use and annotate Figure 4 to support your answer.

Polyethene bag has plastic properties and the steel wire has elastic properties. The difference between the steel wire and polyethene bag is that the steel wire stretches when the weights are added and removed, but the shape of the steel wire does not change, however the polyethene bag also stretches when the weights are added, and when weights are removed, the polyethene bag changes shape.

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As the strain of the polyethene bag increases, when weights are added, the stress increases but when the weights are removed, the stress of the polyethene bag decreases. However, when the weights are added and removed for the steel wire, the stress of the steel wire remains the same.

Lead Examiner comment: *The learner has annotated the graph and has made a comparison in the text about the elastic and plastic properties of the two materials. The learner has also gone on to state what happens to the two materials when the stress is removed, this is a difference. The learner has also identified a similarity in terms of stating that the strain for each material increases as stress is applied. The final section gives a correct statement about the polythene bag but not the steel wire.*

This was a good answer that showed a good understanding of the ideas and gave a comprehensive analysis of the graph and showed lines of argument consistently supported with a logical chain of reasoning. In short all of the key indicators of a Level 3 performance.

Summary

Based on their performance on this paper, learners should:

- Learners should have the opportunity to use the equations listed on the final page of the examination paper and know what each of the symbols stands for in the equations
- Learners should learn the meanings of the terms k, cm/m and g/kg which are used as prefixes to physical quantities or as units after the quantity. Learners should learn how to handle standard form confidently
- Learners should have the opportunity to practice answers to questions with a variety of command words
- Learners should have the opportunity to learn the meanings of command words. This is particularly the case in questions using commands like compare and explain
- Learners need to learn the basic definitions of words such as thermal efficiency, elastic and plastic, ductile and malleable and streamline and the meaning of symbols associated with quantities such as specific latent heat of fusion and work done in stretching a wire/spring
- Learners should be given opportunities to practice answers where lines need to be drawn carefully to show what is taking place, in this case please refer to Q2b to ensure that the examiner is clear as to what the learner is intending to show
- When answering an explain type question, learners need to make sure that they give an expansion to an identification point made. In many cases marks were lost in these questions as there was no expansion
- Centers should be aware that additional guidance on the content that is tested is to be found for this unit on the BTEC L3 Applied Science website via this link.https://qualifications.pearson.com/en/qualifications/btec-nationals/applied-science-2016.coursematerials.html#filterQuery=Pearson-UK:Category%2FExternal-assessments

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